

**Revision
Questions
for
National 5
Physics**

Campbell White

**Formerly Principal Teacher of Physics
Tynecastle High School, Edinburgh**

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Conservation of energy

Energy transfer and conservation

1. (a) What is the symbol that is used for all types of **energy**?
(b) What is the unit of energy, and its abbreviation?
2. Name the types of energy involved in each of the following situations.
 - (a) The energy associated with the fuel used by a vehicle.
 - (b) The energy a vehicle has because of its movement.
 - (c) The energy a vehicle gains when it goes up a hill.
 - (d) The energy that is produced whenever a force of friction is present.
3. What is meant by an **energy transfer**?
4. Describe the main energy transfer in each of the following situations.
 - (a) A car moving off from stationary.
 - (b) A car braking to a halt.
 - (c) A car going uphill at a constant speed.
 - (d) A car going downhill at a constant speed.
5. A sign on a factory wall states:
“Conservation of energy is important in this building.”
 - (a) What is meant by **conservation of energy**?
 - (b) Explain why it is important to conserve energy.
6. Give **three** ways of conserving energy:
 - (a) in the house;
 - (b) in transport.
7. State the **principle of conservation of energy**.
8. A student says: “When a ball rolls down a hill the ball loses energy.”
Explain why this statement is **not** true.

Potential and kinetic energy

- State the relationship that is used to calculate **gravitational potential energy**. Use the symbol for each quantity in the expression.
 - What is the quantity corresponding to each symbol?
 - What is the unit of each quantity, and its abbreviation?
- A 52 kg bag of rubble is raised 1.5 m on to the back of a lorry.
Calculate the potential energy gained by the bag of rubble.
- A skier has a total mass of 105 kg. The skier starts from rest on a slope at a height of 250 m. The skier travels down the slope and then back up the next slope to come to rest at a height of 75 m.
Calculate the loss in potential energy as a result of the run.
- Four tonnes of water every second are allowed to fall through a height of 50 m from behind a dam in a hydro-electric power scheme.
Calculate the energy available every second from this water.
(1 tonne = 1000 kg)
- What type of energy does an object have because of its motion?
- Copy and complete the following sentence.
The greater the _____ and/or the greater the _____ of a moving object, the greater is its kinetic energy.
- State the relationship between **kinetic energy**, **mass** and **speed**. Use the symbol for each quantity in the expression.
 - What is the unit of each quantity, and its abbreviation?
- Calculate the kinetic energy of a trolley of mass 0.75 kg when it is travelling at 2.0 m s^{-1} .
- A car of mass 800 kg is travelling at 26 m s^{-1} (about 60 mph).
A lorry of mass 3000 kg is travelling at 13 m s^{-1} (about 30 mph).
Show by calculation which vehicle has the greater kinetic energy.
- A child has a mass of 38 kg. The child sits at the top of a chute at a height of 5.0 m. On sliding down, the speed of the child at the bottom is 5.5 ms^{-1} .
Calculate the energy transferred by friction.

11. Show that, if air resistance can be ignored, the speed of a falling object is independent of its mass and depends only on the height through which it falls.

12. A stone falls from a cliff which is 80 m high.
 - (a) If air resistance can be ignored, calculate the speed at which the stone enters the water at the bottom of the cliff.
 - (b) What effect will air resistance have on the speed of the stone as it enters the water?
 - (c) In practice, not all of the initial potential energy is transferred into kinetic energy.
Other than kinetic energy, what is the main form of energy produced?

Electrical charge carriers and electric fields

Electrical charge and electrical current

1. What is the difference between an **electrical conductor** and an **insulator**?
2. (a) Give **three** examples of materials that are electrical conductors.
(b) Give **three** examples of materials that are electrical insulators.
3. Name each of the two types of **electrical charge**.
4. Explain why most objects are normally uncharged.
5. (a) Describe a way to make a plastic rod become charged.
(b) Explain why the rod becomes charged.
6. Write a statement about:
(a) the attraction of charges;
(b) the repulsion of charges.
7. Which kind of charge is carried on an **electron**?
8. (a) What is the symbol for charge?
(b) What is the unit of charge, and its abbreviation?
9. What is an **electrical current**?
10. (a) What is the symbol for current?
(b) What is the unit of current, and its abbreviation?
11. State the relationship between **charge**, **current** and **time**.
Use the symbol for each quantity in the expression.
12. Calculate the current in a circuit when a charge of 180 C is transferred in 1 minute.
13. Calculate the charge transferred in a circuit that has a current of 0.25 A for 1 hour.
14. A capacitor stores 20 mC of charge.
During discharge there is an average current of 0.5 μA .
Calculate the time taken to discharge the capacitor.

Alternating and direct current

1. State what is meant by:
 - (a) an **alternating current** (a.c.);
 - (b) a **direct current** (d.c.).
2. What is the purpose of the mains supply or a battery in an electrical circuit?
3. State which of the two types of electricity, a.c. or d.c., is supplied by:
 - (a) the mains supply;
 - (b) a battery.
4. Draw the pattern that would be seen on a suitably adjusted oscilloscope when it is connected to:
 - (a) a source obtained from the mains supply;
 - (b) a battery.

Electric fields

1. What is an **electric field**?
2. What effect does an electric field have on charges?
3. (a) Describe a way to represent an electric field in a diagram.
(b) Describe a way to represent the strength of an electric field in a diagram.
(c) (i) Describe a way to represent the direction of an electric field.
(ii) What is the convention normally used?
4. (a) Draw a diagram to represent an electric field around a positive point charge.
(b) What term is used to describe the field?
5. (a) Draw a diagram to represent an electric field between two parallel charged plates.
(b) What term is used to describe the field?
6. What happens to free electric charges in a conductor when an electric field is applied to the conductor?
7. (a) What happens to a charged particle moving parallel to a uniform electric field?
(b) What happens to a charged particle that enters a uniform electric field while moving initially at right angles to the field?

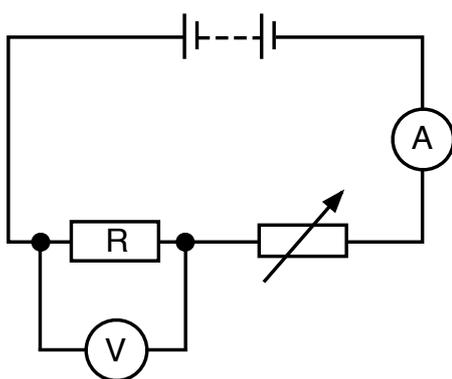
Potential difference (voltage)

1. What is meant by **potential difference (voltage)**?
2. (a) What is the symbol for **potential difference (voltage)**?
(b) What is the unit of potential difference (voltage), and its abbreviation?
3. What happens to the brightness of a lamp when the potential difference across it is increased?
4. Two quantities in electricity that are often confused are **voltage** and **current**.
Show that you understand the differences between these quantities by explaining what is meant by each of them.

Ohm's law

Resistance

1. What is meant by the **electrical resistance** of a resistor?
2. What energy transfer takes place in a resistor?
3. (a) What is the symbol for **resistance**?
(b) What is the unit of resistance, and its abbreviation?
4. State what happens to the current in a circuit when the resistance in it is increased.
5. (a) State the relationship between **potential difference (voltage), current and resistance**.
Use the symbol for each quantity in the expression.
(b) What is the unit of each quantity, and its abbreviation?
6. Describe a way to show the relationship between resistance, current and voltage in a simple circuit.
Your description should include:
the circuit diagram(s);
the steps taken to show the relationship.
7. A student sets up the circuit shown to measure the resistance of resistor R. The following results are obtained.



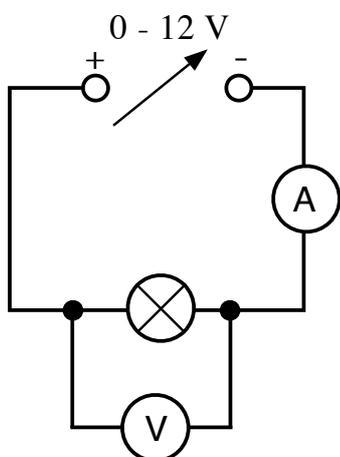
<i>Reading on voltmeter (V)</i>	<i>Reading on ammeter (mA)</i>
0.7	13
1.4	25
2.8	50
4.2	75
5.6	100

- (a) Describe the way that the circuit is used to give the set of results.
- (b) Plot a graph of the voltmeter readings against the ammeter readings for these results.
- (c) Use the graph to determine the resistance of resistor R.

8. State Ohm's law for a conductor.
9. (a) What name is given to the ratio V/I for a resistor?
(b) What happens to the ratio V/I for a resistor when the current in the resistor changes?
10. (a) What is an ohmic conductor?
(b) Give the names of **two** ohmic conductors.
11. (a) What is a non-ohmic conductor?
(b) Give the names of **two** non-ohmic conductors.
12. State the relationship between the **temperature** and the **resistance** of a conductor.

Calculations

1. A student sets up the circuit shown to investigate the resistance of a filament lamp. The following results are obtained.



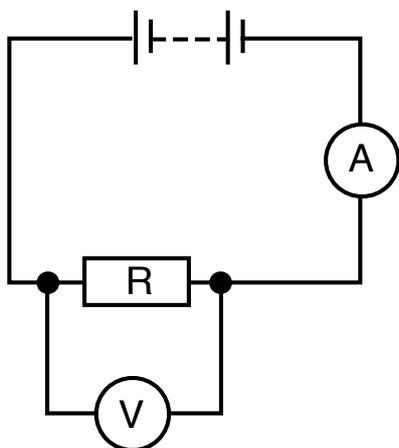
<i>Reading on voltmeter (V)</i>	<i>Reading on ammeter (A)</i>	<i>Resistance of lamp (Ω)</i>
0.5	0.10	
1.0	0.20	
2.0	0.38	
3.0	0.44	
5.0	0.49	
7.0	0.51	

- (a) (i) Plot a graph of the voltmeter readings against the ammeter readings for the results.
- (ii) Use the graph to determine the ammeter reading when the potential difference across the lamp is 4.0 V.
- (b) Complete the table to show the resistance of the lamp for the different meter readings.
- (c) (i) In what way does the resistance of the lamp change as the current increases?
- (ii) Explain your answer.
2. A car headlight lamp is connected across a 12 V car battery. The current in the lamp is 3 A. Calculate the resistance of the lamp.
3. A resistor of resistance 180Ω is connected across a 9 V battery. Calculate the current in the resistor.
4. Calculate the potential difference across a $1 \text{ k}\Omega$ resistor when the current in it is 10 mA.

5. Calculate the resistance of resistor R in the circuit shown, from the information given.

Reading on voltmeter = 9.0 V

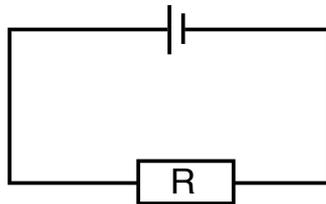
Reading on ammeter = 50 mA



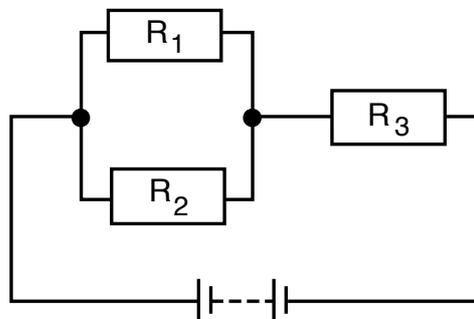
Practical electrical and electronic circuits

Current, voltage and resistance in circuits

- Name the type of meter used to measure:
 - current;
 - voltage;
 - resistance.
 - Draw the circuit symbol for each of the **three** meters.
- Draw a diagram to show the way that:
 - an ammeter is connected into a circuit;
 - a voltmeter is connected into a circuit;
 - an ohmmeter is used.
- Redraw the following circuit to include:
 - a meter to measure the current in the resistor R;
 - a meter to measure the potential difference across the resistor R.

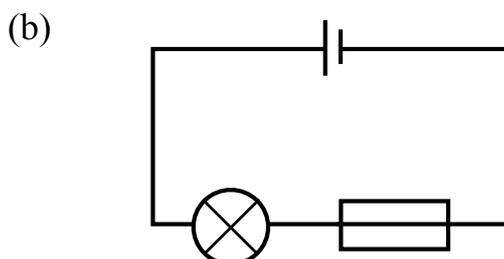
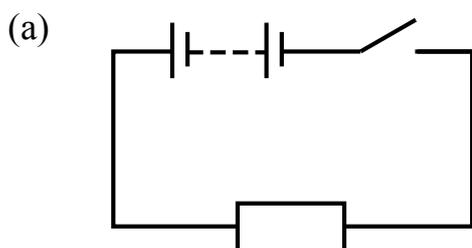


- Redraw the following circuit to include a meter to measure the current in resistor R_1 and a meter to measure the potential difference across resistor R_3 .



Electrical and electronic components

1. Draw the circuit symbol for:
 - (a) (i) a cell;
 - (ii) a battery;
 - (iii) a lamp;
 - (iv) a switch;
 - (v) a resistor;
 - (vi) a fuse.
 - (b) State the purpose of each of the **six** components.
2. Starting at the source of energy and working clockwise, name the components in each of the following circuits.



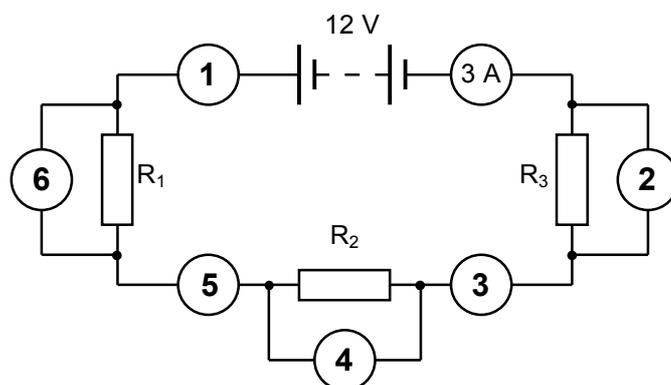
3.
 - (a) What is the purpose of a **variable resistor** in a circuit?
 - (b) Draw the circuit symbol for a variable resistor.
 - (c) Give **two** practical uses for a variable resistor.
4. Name **two** electrical components that have a resistance that changes due to a change in the physical conditions.
5.
 - (a) What is the purpose of a **motor** in a circuit?
 - (b) Draw the circuit symbol for a motor.
6.
 - (a) What is a **diode**?
 - (b) Draw the circuit symbol for a diode.
7.
 - (a) What does **LED** stand for?
 - (b) Draw the circuit symbol for an LED.
 - (c) Indicate the direction that electrons flow in an LED as it emits light.
 - (d) Give a use for an LED.
8. An LED is connected in a circuit and it emits light.
What happens when the connections to the LED are then reversed?

9. Explain why a resistor is needed in series with an LED.
10. Draw a diagram of a circuit that will allow an LED to light. Include the series resistor and make sure the LED is connected in the correct way to the supply.
11. An LED is used in a circuit with a 12 V supply. The potential difference across the LED is 2 V and the current in it is 10 mA.
Calculate the value of the resistor that is connected in series with the LED.
12. (a) Draw the circuit symbol for a **microphone**.
(b) State the energy transfer taking place in a microphone.
13. (a) Draw the circuit symbol for a **loudspeaker**.
(b) State the energy transfer taking place in a loudspeaker.
14. (a) Draw the circuit symbol for a **photovoltaic cell**.
(b) State the energy transfer taking place in a photovoltaic cell.
(c) Give **two** uses for a photovoltaic cell.
15. (a) What is the origin of the name '**thermistor**'?
(b) What is a thermistor?
(c) Draw the circuit symbol for a thermistor.
(d) Give a use for a thermistor.
16. A thermistor has a resistance of 30 Ω when hot. The potential difference across it is 9 V.
Calculate the current in the thermistor.
17. (a) What does **LDR** stand for?
(b) What is an LDR?
(c) Draw the circuit symbol for an LDR.
(d) Give **two** uses for an LDR.
18. An LDR has a current of 10 mA in it and a potential difference of 4 V across it.
Calculate the resistance of the LDR.
19. (a) Draw the circuit symbol for a **relay**.
(b) Give a use for a relay.

20. (a) What is the purpose of a **capacitor** in an electronic circuit?
(b) Draw the circuit symbol for a capacitor.
21. (a) Draw a circuit that could be used to charge a capacitor.
(b) What happens to the potential difference across a capacitor during the time it is charging?
(c) Sketch a graph of the potential difference across a capacitor during the time it is charging.
22. A capacitor is connected across a 9 V battery.
(a) When does the capacitor stop charging?
(b) What does the time taken to charge a capacitor depend on?
23. A capacitor is fully charged when the potential difference across it is the same as the supply voltage.
In what way could the time taken to fully charge this capacitor be reduced, using the same supply voltage?
24. In what way can a charged capacitor be quickly discharged?
25. Draw the circuit symbol, labelling the terminals, for
(a) an **npn transistor** (bipolar transistor);
(b) an **n-channel enhancement mode MOSFET**.
26. (a) Give a use for a transistor.
(b) “A transistor has two possible states – it can be ON or OFF.”
Explain what is meant by this statement.

Series and parallel circuits

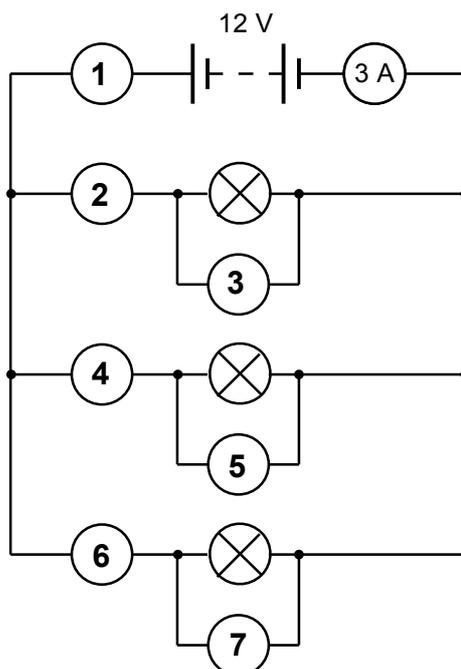
- What is meant by a **series circuit**?
 - Draw a circuit diagram showing a resistor and a lamp in a series circuit with a cell.
- Write a statement about the current at all points in a series circuit.
- State the relationship between the voltage of the supply and the voltages across the components in a series circuit.
- By considering the relationship between the voltage of the supply and the voltages across the components in a series circuit, show that the law of conservation of energy applies.
- In the circuit shown, all of the resistors are identical.



State the value, with units, on each of the meters **1** to **6**.

- Give an application in the home that uses **two** switches in series.
- What is meant by a **parallel circuit**?
 - Draw a circuit diagram with a cell showing two resistors, R_1 and R_2 , in parallel.
- State the relationship between the current drawn from the supply and the currents in parallel branches in a parallel circuit.
- Write a statement about the voltage across resistors connected in a parallel circuit.

10. In the circuit shown all of the lamps are identical.



State the value, with units, on each of the meters **1** to **7**.

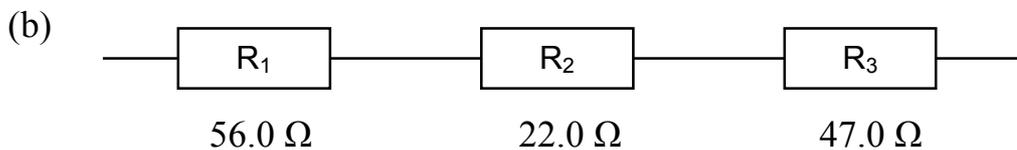
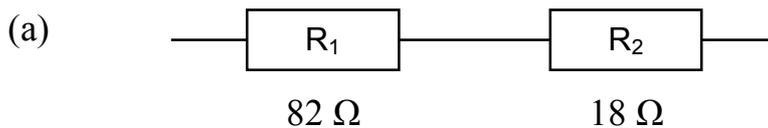
11. Explain why connecting too many household appliances to one electrical socket is dangerous.
12. Draw a circuit diagram to show the way that all four car sidelights are connected to the car battery.
13. Draw a circuit diagram to show the way that the two headlights in a car can only be switched on when the ignition switch and the light switch are both on.
14. Car brakelights only go on when the ignition is switched on and the brake switch is pressed.
Draw the circuit diagram for this arrangement.
15. The interior light in a car goes on when either the driver's door or the passenger's door is opened.
- What happens to the door switch when a door is opened?
 - Draw the circuit diagram used to switch the light on.
16. State what is meant by:
- an **open circuit**;
 - a **short circuit**.

17. (a) Describe how to make a simple continuity tester using a battery and a lamp. Include a diagram of the circuit used in your description.
- (b) Describe how this continuity tester can be used to test for faults in a circuit.
18. State the reading on an ohmmeter when it is placed across:
- (a) an open circuit;
- (b) a short circuit.
19. (a) Are appliances connected in series or in parallel when they are connected to the mains through the wiring of a house?
- (b) Is the lighting circuit in a house a series circuit or a parallel circuit?
20. (a) Describe what is meant by a ring main circuit.
Use a circuit diagram to help your description.
- (b) What are the advantages of using a ring main circuit instead of a simple parallel circuit?
- (c) Give **two** differences between the lighting circuit and the ring main circuit in the wiring of a house.
21. (a) What is the purpose of the mains fuses in the mains wiring of a house?
- (b) Explain the way that the mains fuses do the job that they are designed to do.
22. (a) Explain why more than one mains fuse is necessary in the mains wiring of a house.
- (b) Explain why different values of mains fuses are required in the mains wiring of a house.

Resistors in circuits

- Draw a diagram showing **three** resistors R_1 , R_2 and R_3 in series.
 - State the relationship between the resistances R_1 , R_2 and R_3 and R_T , the total resistance.
 - What happens to the total resistance of a circuit when resistors are connected in series?

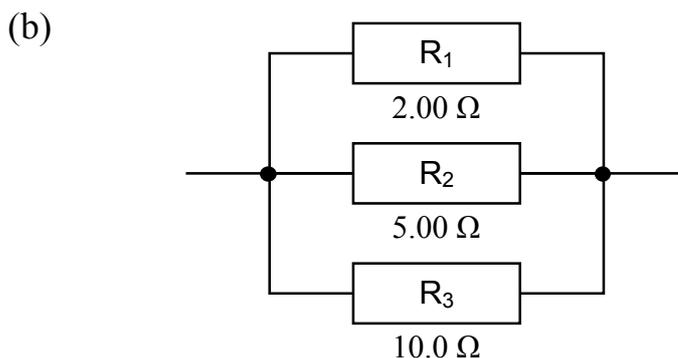
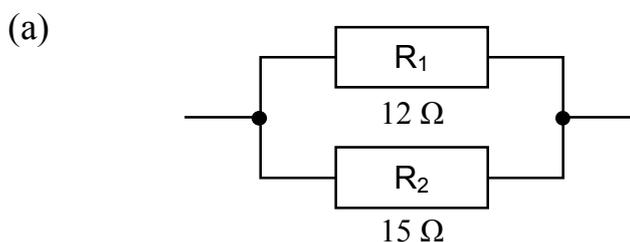
- Calculate the total resistance of each of the following combinations.



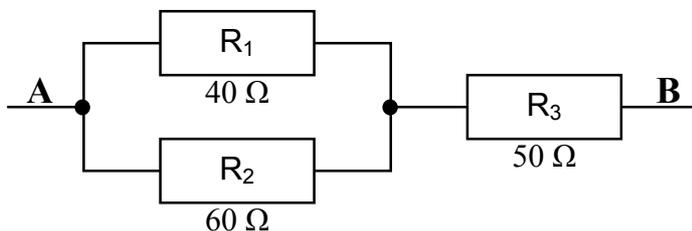
- Three resistors of values $2.20\ \Omega$, $4.70\ \Omega$ and $5.60\ \Omega$ are connected in series. Calculate the total resistance of this combination.

- Draw a diagram showing **three** resistors R_1 , R_2 and R_3 in parallel.
 - State the relationship between the resistances R_1 , R_2 and R_3 and R_T , the total resistance.
 - What happens to the total resistance of a circuit when resistors are connected in parallel?

- Calculate the total resistance of each of the following combinations.

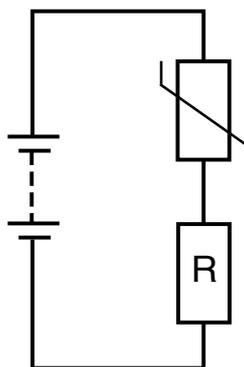


- Resistors of values $10\ \Omega$, $12\ \Omega$ and $15\ \Omega$ are connected in parallel. Calculate the total resistance of this combination.
- Calculate the total resistance between points **A** and **B** in the circuit shown.

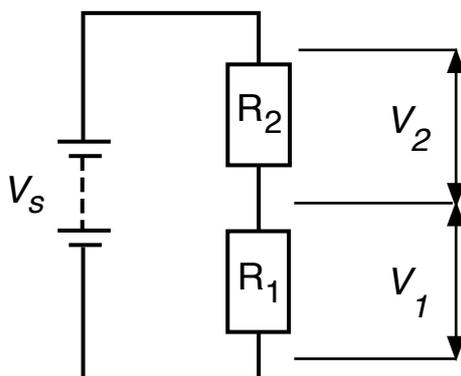


Potential divider circuits

- What is a **potential divider circuit**?
 - What is the purpose of the resistor R in the circuit shown?

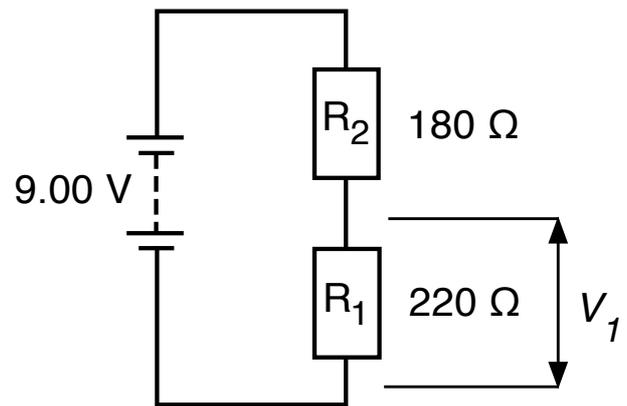


- Consider the potential divider circuit shown.



- State the relationship between V_1 , V_2 , R_1 and R_2 .
- State the relationship between V_s , V_1 and V_2 , and use this to find the relationship for V_1 in terms of V_s , R_1 and R_2 .

3. Calculate the potential difference V_1 in the potential divider circuit shown.



4. A potential divider consists of a resistor R_1 of value $1000\ \Omega$ in series with a resistor R_2 of value $1500\ \Omega$. It is connected across a supply voltage of $2.5\ \text{V}$.
- (a) Draw the circuit diagram.
- (b) Calculate the voltage across R_1 .
5. A potential divider consisting of two resistors is used to 'tap off' exactly half of a supply voltage.
- What is the relationship between the resistances of the two resistors?