Stewards Academy

Science KS4: Blended Learning Booklet

P2 Electricity

Name:

Form:

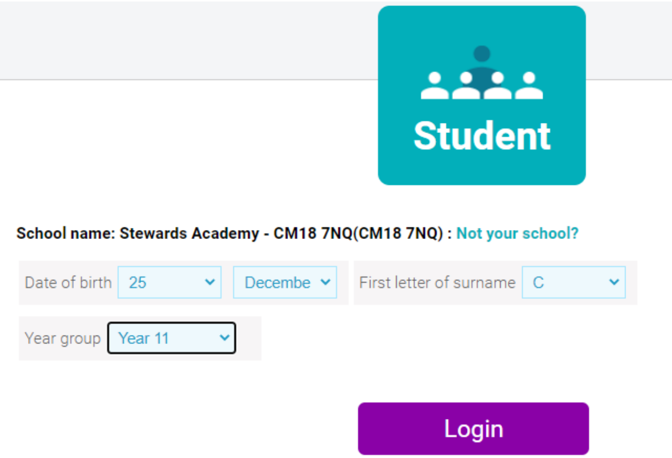
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in "stewards" and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year



Contents

Contents

(T) = Triple scientists only

Big Picture – Year 10 Overview
Science

Year 10

Health

UNIT B4

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. I will be able to explain how communicable diseases are spread and how we can control their spread. *I will be able to describe how plants are affected by and protected from disease causing organisms (T).*

- Health and disease
- Pathogens
- Malaria
- Protecting the body
- *Plant diseases & defenses (T)*
- Unit Test

Chemical changes

UNIT C4

I will be able to describe why some metals are more reactive than others, I will be able to describe how neutralization occurs and how salts are formed. I will be able to explain how some metals are extracted by electrolysis rather than oxidation

- Metal reactivity
- Neutralisation
- *Titration (T)*
- Electrolysis
- Oxidation and reduction)
- Unit Test

Atomic structure

UNIT P4

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. I will be able to represent radioactive decay using a nuclear equation.

- Atomic structure
- Radioactive decay
- Nuclear equations
- Hazards and uses of radiation
- *Nuclear fission and fusion (T)*
- Unit Test

Homeostasis

UNIT B5

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. I will be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

- Homeostasis
- *The nervous system and the eye (T)*
- The endocrine system and the kidneys (T)
- Human reproduction and IVF
- Plant hormones (T)
- Unit Test

Energy Changes & Reaction Rates

UNIT C5 & C6

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. *I will be able to explain how dells produce a voltage and how fuel cells work (T).* I will be able to measure and calculate the rate of a reaction and describe factors that can affect rate. *I will be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

- Exo and endo thermic reactions
- Reaction profiles
- *Cells, batteries and fuels cells (T)*
- Measuring rates of reaction
- Factors affecting rates of reaction
- Catalysts and collision theory
- Reversible reactions and energy changes
- Factors affecting equilibrium
- Unit Test

Forces

UNIT P5

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. *I will be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

- Forces, speed and acceleration
- Mass and Weight
- Momentum and road safety
- *Moments, levers and pressure (T)*
- Forces and energy in springs
- Unit Test

Genetics

UNIT B6

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. I will be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. *I will be able to describe the work by Gregor Mendel around plant genetics*

- DNA, genes and the human genome
- *DNA structure and protein production (T)*
- Meiosis and reproduction
- Genetics and gene disorders
- *The work of Gregor Mendel (T)*
- Unit Test

Hydrocarbons & Chemical analysis

UNIT C7 & C8

I will be able to describe the properties of hydrocarbons. *I will be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* I will be able to use techniques to produce and identify a pure substance. *I will be able to identify positive and negative ions and evaluate different analysis techniques (T).*

- Crude oil, hydrocarbons and fractional distillation
- Combustion and cracking of alkanes
- *Alkenes, alcohols and carboxylic acids (T)*
- *Polymers and poly-merisation (T)*
- Pure substances and chroma-tography
- Tests for gases, metals, hydroxides and anions (T)
- *Spectroscopy and other instrumental methods (T)*
- Unit Test

Waves

UNIT P6

I will be able to describe characteristics of waves that can be measured. I will be able to measure reflection and refraction of waves and explain why they occur. I will be able to place visible light withing the electromagnetic spectrum. *I will be able to sound waves can reveal structures (T). I will be able to explain how lenses work (T)*

- Properties of waves
- *Sound waves and seismic waves (T)*
- The electro-magnetic spectrum
- *Colour, lenses, images and magnification (T)*
- *IR emission and absorption (T)*
- Unit Test

End of Year Exams

Nest Year

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Electricity: Year: 9 Unit: P2

AIMS

This topic will cover key concepts in electricity. Students will be able to explain the characteristics of some electrical components and explain how electricity can be used safely in the home. They will learn about electrical current, investigate different types of circuit and learn some of the key features of each type of circuit. Students will distinguish between current and potential difference and investigate factors that affect resistance in a circuit. They will discover how electricity is transmitted to homes and the features of mains electricity. They will investigate power and energy transfers and calculate power.

DEVELOPING COURAGE

C Ability to understand how domestic electricity and billing works

O Investigate the flow of an electrical current in a wire

U Work together to create models to show how electricty works

R Use of equations for electricity

A How lucky we are to have electrical energy at the flick of a switch

G Share expertise to carry out practicals

E Learning how to be set up a working electrical circuit

UP NEXT

Particle model

- Density
- States of matter
- Internal energy
- Specific heat capacity
- Specific latent heat
- Particle motion & gas pressure

CAREERS

- Electrician
- Electrical engineer
- Sound & lighting engineer

PREVIOUS LEARNING

Pupils will have some knowledge of how an electric current is due to the flow of charge. That the current in a circuit can be controlled by resistors. Cells provide a source of electrical energy; batteries are a number of cells joined together. The electrical supply in a home is alternating current (ac) and that mains electricity has a high potential difference. Fuses switch off the current if a fault occurs.

WHAT WE KNOW/ REMEMBER

- ………………………………
- ………………………………
- ………………………………
- ………………………………
- ………………………………

RECOMMENDED READING

1. Charging About: The Story of Electricity (Science Works) by Jacqui Bailey and Matthew Lilly.
2. Electricity (Essential Physical Science) Paperback – by Louise Spilsbury and Richard Spilsbury.
3. EYEWITNESS GUIDE:77 by Steve Parker

PERSONAL OBJECTIVES

- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………
- ……………………………………

Lesson 1: P2.1 – Static Electricity

Connection

Have a look at the topic overview and the P2 zoom in.

Populate what you know and your personal objectives.

Activation

•**LI: describe how insulating materials can become charged, know that there are two kinds of electric charge**

1. https://www.youtube.com/watch?v=gJhu9mH-RTM
2. Read pages 48-49
3. Define "Insulator", "Conductor", "Attract" and "Repel" Using the glossary.
4. Draw and label figure 2.3
5. State what charge Perspex, Acetate, Polythene and Glass becomes when rubbed.
6. https://phet.colorado.edu/sims/html/balloons-and-static-electricity/latest/balloons-and-static-electricity_en.html shows electron transfer
7. Write three sentences to describe electron transfer

Demonstration

Attempt questions 1-5.
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.1 – Static Electricity

Connection

1 NA
2 NA
3 NA

Demonstration

1 e.g. a polythene rod
1b e.g. a metal wire
2 If static charge begins to build up on a conductor when you are rubbing it with a cloth, charge will flow through the conductor through you to the ground.
3a attract
3b repel
3c attract
3d repel
4 Her hair builds up static charge. Since the type of charge is the same on each strand of hair (either all positive or all negative) then the strands of hair repel each other.
5 Electrons move from the duster to the polythene so the duster loses negative charge. Therefore, it builds up positive charge.

Lesson 2: P2.2 – Electric Fields

Connection

Q1. What happens when two positive charges are brought together?

Q2. Name two materials that become positively charged?

Q3. Why do materials become charged?

Activation

LI: Explain what an electric field is, draw an electric field pattern for a charged sphere

1. https://www.youtube.com/watch?v=rPbx_XrrKLQ&t=3s
2. Read pages 50-51
3. Define "Electric field" using the glossary
4. Draw and label figure 2.5
5. Draw a diagram to show the electric field around a negative point charge.
6. Copy the first paragraph of the third section, Sparking
7. Draw and label figure 2.7

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: P2.2 – Electric Fields

Connection

1 They repel
2 Glass, Acetate and Perspex
3 Materials become charged when they gain or lose electrons

Demonstration

1 The direction of the arrows is the direction that the force acts on a positive charge. A positive charge placed in the field in Figure 2.5 would feel a force of repulsion, so it would always be acting away from the centre.
2 Positive charges would feel a force of attraction towards the negative charge in the middle. Therefore, the lines should all be pointing inwards to the centre.
3 The size of the force remains the same because the electron is always at the same distance from the charged sphere.
4a Anywhere close to the central charge.
4b Anywhere far away from the central charge.
5 The arrows show the direction that the electric field acts on a positive charge – which is useful. This could be misleading, however, if you are considering a negative charge in the field as the force would act the opposite way.
6 No – because a spark occurs when particles break apart due to an electric field and a vacuum doesn't have any particles in it.
7 The electric field between two charged objects is stronger if the objects are closer together. Sparks are more likely to occur in stronger electric fields.
8 The rate that lightning strikes should increase. When the cloud passes over a hill, the distance between it and the ground becomes smaller – this creates a stronger electric field.

Lesson 3: P2.3 – Electric Current

Connection

Q1. Draw the electric field for a point positive charge

Q2. The further away you get from a point charge the **stronger/weaker** the field gets

Q3. What is a spark?

Activation

LI: Recall the definition of current and the equation for current, Define Ohms law

1. https://www.youtube.com/watch?v=kYwNj9uauJ4
2. Make a note of the title and the LI
3. Read pages 52-53
4. Define using the glossary "Current", "Resistance", and "Potential difference"
5. Copy the equation for current with units.
6. Copy the equation that links potential difference, current and resistance with units
7. Use these simulation 1 and 2 to demonstrate how changing resistance and potential difference affect the current

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

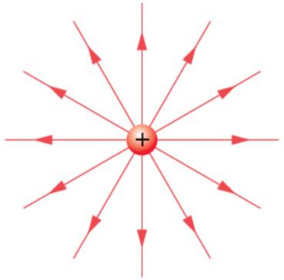
Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.3 – Electric Current

Connection

1



2 The further away you get from a point charge the **weaker** the field gets

3 A spark is when air is broken down into ions by strong electric fields and those ions move due to that electric field.

Demonstration

1 $I = Q / t = 80 / 16 = 5$ A
2 $t = Q / I = 96 / 6 = 16$ s
3 There needs to be a source of potential difference within a complete loop in a circuit.
4 6V battery transfers 6J of energy per coulomb of charge. Number of coulombs of charge, $Q = It = 1 \times 60 = 60$ C. Therefore total energy transferred = $6 \times 60 = 360$ J
5 Electrons transfer energy to the kinetic energy stored in the metal ions. This makes them move faster and therefore become hot.
6 If you increase the resistance of the variable resistor, the current decreases. The lamp will get dimmer if the current decreases.
7 $R = V / I = 12 / 3 = 4\ \Omega$
8 $V = IR = 1.5 \times 6 = 9$ V

Lesson 4: P2.4 – Series and Parallel Circuits

Connection

Q1. What is the unit of charge?

Q2. What is the equation that links, current, resistance and potential difference?

Q3. What happens to the resistance in a resistor as it gets hotter?

Activation

LI: Investigate the differences in resistance, p.d. and current in series and parallel circuits

1. https://www.youtube.com/watch?v=WUR4oAKqWHc
2. Make a note of the title and the LI
3. Read pages 54-55
4. Define "Series" and "Parallel" using the glossary
5. Draw figure 2.14 and write a statement about the current, resistance and potential difference
6. Draw figure 2.15 and write a statement about the current, resistance and potential difference
7. https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html shows features of series and parallel circuits

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.4 – Series and Parallel Circuits

Connection

1 Coulombs
2
Potential difference = current x resistance
3 Resistance increases as the temperature of a resistor increases. This is because the ions vibrate more and make it harder for the electrons to flow around the circuit.

Demonstration

1 Close the switches
2 They both get dimmer and they are the same brightness as each other (and the third lamp)
3 In the series circuit both light bulbs would not be shining; in the parallel circuit the unscrewed bulb would not be shining but the other bulb would continue to shine.
4a 0.4 A –the current through components in series is the same
4b 10 Ω + 20 Ω = 30 Ω
4c 8 V –the potential difference of the power supply (12 V) is shared between the components (4 V and 8 V)
4d The current would be half as big because the total resistance has doubled from 30Ω to 60Ω.
5a 0.6 A –the current from the supply (1.8A) is the sum of the currents through the motor (1.2A) and the lamp. So the current through the lamp = 1.8 –0.6 = 1.2 A.
5b 12 V –the potential difference across each component in a parallel circuit is the same and is equal to the p.d. of the power supply.
5c It must be smaller than 10 Ω. Connecting resistors in parallel decreases the total resistance, so connecting the lamp to the motor in parallel would make the resistance less than the resistance of the motor.
5d Adding the resistor decreases the total resistance, therefore the battery will be providing a bigger current.

Lesson 5: P2.5 – Investigating Circuits

Connection

Q1. Define a series circuit

Q2. Define a parallel circuit

Q3. Describe the flow of electrons in a series and parallel circuit

Activation

LI: Use series circuits to test components and make measurements, carry out calculations on series circuits

1. https://www.youtube.com/watch?v=dVWdyLTHJgg
2. Make a note of the title and the LI
3. Read pages 56-57
4. Describe how to use an ammeter
5. Describe how to use a voltmeter
6. Draw and label figure 2.18 to show equivalent resistance
7. https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html how to construct series and parallel circuits

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.5 – Investigating Circuits

Connection

1 A series circuit is where the components are in a single loop

2 A parallel circuit is where the components are on multiple branches

3 In a series circuit the electrons flow around the loop passing through each component in turn.

In a parallel circuit the electrons flow around the circuit but when the electron comes to a branch they can either go down one branch or the other.

Demonstration

1. If the component or the cable is able to conduct electricity, then a current flows in the circuit when it is connected between the terminals. This makes the buzzer sound.

2. (a) R = V / I = 12 / 2 = 6Ω

2. (b) You can adjust the variable resistor (either by moving a slider or by rotating a dial) so that its resistance increases.

3. The voltmeter needs to be connected in parallel to the resistor. Its high resistance means that no measurable current flows when it is connected in series.

4. R = V / I = 12 / 0.6 = 20 Ω

5. Total resistance, R = 5 + 7 = 12 Ω I = V / R = 6 / 12 = 0.5 A

6. Total resistance, R = 3 + 6 = 9 Ω Current, I = V / R = 12 / 9 = 1.33 A Therefore p.d. across 3 Ω resistor = IR = 1.33 × 3 = 4V

7. The potential difference across the 3Ω resistor =I× R = 3 V. The current through the 6 Ω resistor is also 1 A so the p.d. across the 6 Ω resistor = 1 × 6 = 6 V. Therefore, the p.d. of the battery = 3V + 6V = 9V.

8. The current through the 4 Ω resistor = V / R = 8 / 4 = 2 A. Therefore, the current through the other resistor = 2 A. The potential difference across the other resistor = 12 – 8 = 4 V. So the resistance = V / I = 4 / 2 = 2 Ω.

9. The total p.d. stays the same (12 V) and the current increases. Since R = V / I this means that the equivalent resistance of the circuit gets less.

10. The same current will pass through a 9 V battery connected to a 9 Ω resistor. Therefore, the current = V / R = 9 / 9 = 1 A.

Lesson 6: P2.6 – Circuit Components

Connection

Q1. If there is a potential difference of 2V across a bulb with 4A running through it, what is the resistance of the bulb?

Q2. What is the current through the same bulb in Q1 if the potential difference is doubled.

Q3. What is the total resistance of two bulbs that are the same as in Q1 in series?

Activation

LI: Compare the properties of a resistor and filament lamp, investigate the changing resistance of a filament lamp

1. https://www.youtube.com/watch?v=hfPK6Lxdlfg
2. Make a note of the title and the LI
3. Read pages 58-59
4. Draw figure 2.19. and 2.20
5. Write down how to find the resistance of an IV graph.
6. Draw figure 2.22
7. Describe how the resistance of a filament lamp changes over time.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: P2.6 – Circuit Components

Connection

1 R= V/I = 2V/4A= 0.5Ω
2 I=V/R = 4V/0.5Ω = 8A

3 R = $R_1 + R_2$=0.5+0.5=1 Ω

Demonstration

1 They are directly proportional to each other.
2 The voltmeter is connected in parallel.
3 The I -V graph is not a straight line through the origin.
4 Tungsten obeys Ohm's law when the temperature remains constant. In a filament lamp the temperature increases as more current flows through it (to thousands of degrees), so the lamp does not obey Ohm's law.
5a At 1 V: R = V / I = 1 / 0.2 = 5 Ω At 6 V: R= V / I= 6 / 0.4 = 15 Ω
5b Graph should show the resistance starting at a low value (not 0 Ω) and then rapidly rising to a higher, steady value as the filament lamp heats up to a constant temperature.

Lesson 7 P2.7 – Investigate the I–V characteristics of a filament lamp, a diode and a resistor at constant temperature

Connection

Q1. As the temperature of a wire increases, the resistance **increases/decreases**

Q2. If there is a potential difference of 2V across a bulb with a resistance of 1Ω, what is the current flowing through it?

Q3. why does the resistance in a component change as the temperature changes?

Activation

LI: interpret and explain graphs using scientific ideas

1. https://www.youtube.com/watch?v=ksPfzUjMbBk
2. Make a note of the title and the LI
3. Read pages 60-61
4. Draw and label figure 2.23
5. Write down a 5 step method for finding the resistance of different components.
6. Draw and label figure 2.24

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.7 – Investigate the I–V characteristics of a filament lamp, a diode and a resistor at constant temperature

Connection

1 As the temperature of a wire increases, the resistance **increases**

2 I=V/R=2/1=2A

3 The resistance changes in components as the temperature changes because the ions start to vibrate and this resists the flow of electrons in a wire.

Demonstration

1 The meters only work properly if the ammeter is in connected in series and the voltmeter is connected in parallel.
2 The independent variable is the current and the dependent variable is the potential difference.
3 To stop the temperature increasing.
4 The current is directly proportional to the potential difference.
5 The lamp is not an ohmic conductor. Its resistance increases as the current and potential difference become higher positive and negative values.
6 The diode has a very high resistance when the potential difference is negative and it has a very low resistance when the potential difference is positive.

Lesson 8: P2.8 – Investigate the factors affecting the resistance of electrical circuits

Connection

Q1. Draw the circuit symbol for a resistor, a bulb and a diode

Q2. Draw the IV graph for a diode

Q3. Describe the IV graph for a diode

Activation

LI: Use a circuit to determine resistance, gather valid data to use in calculations

1. https://www.youtube.com/watch?v=m_3JrA-sDEg
2. Make a note of the title and the LI
3. Read pages 62-63
4. Draw figure 2.25
5. Using section 2, describe a method to test the resistance of different lengths of wire.
6. Draw and label figure 2.26 and 2.27
7. https://javalab.org/en/resistance_connection_en/ describe resistors in parallel and series

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.8 – Investigate the factors affecting the resistance of electrical circuits

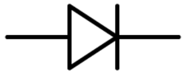
Connection

1

bulb

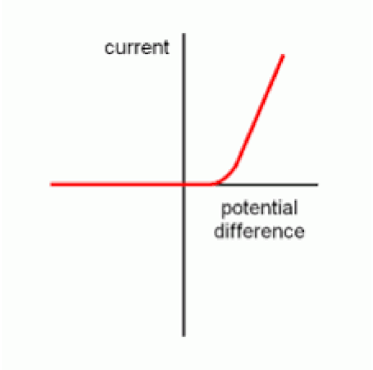
resistor

2



Diode

3 The diode only allows current to flow in one direction.



Demonstration

1 You would expect the current to increase as the p.d. across it is increased. This is because I= V/ R.

2 You could either vary the setting on the power supply between 0 V and 12 V or you could alter the resistance of the variable resistor (usually by moving a slider or by rotating a dial).

3 The temperature is also likely to increase.

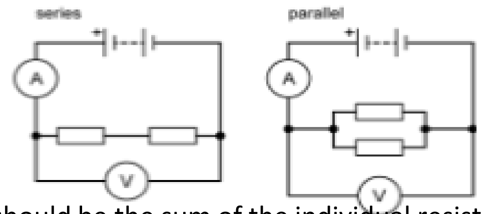
4 In order to measure the resistance of the wire you would need to measure the p.d. across the wire by using a voltmeter connected in parallel and you would need to measure the current flowing though the wire by connecting an ammeter in series. You would then calculate the resistance by dividing the p.d. by the current. The wire would also need to be in a series circuit with a power supply and a variable resistor. Calculate the resistance for different lengths of wire, which you can measure with a ruler.

5a The resistance should be directly proportional to the length.

5b A graph of resistance on the y-axis against length on the x-axis should be a straight line (with a positive gradient) through the origin.

6 To keep the temperature constant, you could measure the temperature of the wire using a thermometer and adjust the p.d until the temperature is the same each time.

7a



7b In series, the combined resistance should be the sum of the individual resistances. In parallel the combined resistance should be less than the smallest individual resistance.

8a First resistance = V / I = 6 / 0.1 = 60 Ω Second resistance = 3 / 0.2 = 15 Ω. Therefore the expected value of the total resistance = 60 + 15 = 75 Ω. The student obtained a value of 3.9 / 0.05 = 78 Ω which is higher than expected.

8b Higher resistance is unlikely to be due to a gain in temperature since the current is actually lower than before. Extra resistance is likely to be from the contact between the resistors. Another possible reason is from inaccurate measurements such as rounding error in the current reading.)

Lesson 9: P2.9 – Control Circuits

Connection

Q1. There are two wires, one short and the other long. Which wire has the highest resistance?

Q2. There are two wires, one thin one and a thick one. Which wire has the highest resistance?

Q3. Why describe why the resistance changes as you change the length of a wire.

Activation

LI: use a thermistor and a light-dependent resistor (LDR), investigate the properties of thermistors, LDRs and diodes

1. https://www.youtube.com/watch?v=up4VDysf7_U
2. Make a note of the title and the LI
3. Read pages 64-65
4. Define “thermistor”, “Light dependant resistor”, and “diode” using the glossary
5. Copy and label figure 2.29, figure 2.30 and figure 2.32

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.9 – Control Circuits

Connection

1 The long wire
2 The thin wire
3 The longer the wire the more ions there are for the electrons to bump into. This creates a higher resistance.

Demonstration

1 The resistance of the LDR.
2 When the temperature increases, the resistance decreases.
3 The I -V graph is not a straight line through the origin.
4 The temperature increases when the current increases. You can work out the resistance by reading off the graph and dividing the p.d. by the current. At higher values of current (and therefore higher temperatures) the resistance is a lower value.
5 When you cover the LDR, the resistance increases so the current decreases. When you uncover the LDR the opposite happens so the current increases.
6 The current passing through the diode is very small when the p.d. is negative. Therefore, a diode has a very high resistance when the p.d. is negative.
7 The resistance of a diode is very small when the current goes through it in the allowed direction. This might allow the current to become dangerously high and damage the diode. An extra resistor prevents the current from becoming too high.

Lesson 10: P2.10 – Electricity in the home

Connection

Q1. Draw the symbol of an LDR, thermistor and diode

Q2. Describe how a thermistor works

Q3. Describe how an LDR works

Activation

LI: Recall that the domestic supply in the UK is a.c. at 50 Hz and about 230 V, describe the main features of live, neutral and earth wires

1. https://www.youtube.com/watch?v=UEfP1OKKz_Q
2. Make a note of the title and the LO
3. Read pages 66-67
4. Draw and label figure 2.34
5. State the frequency and potential difference of UK mains electricity
6. Draw and label figure 2.35
7. https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html show how a fuse works.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

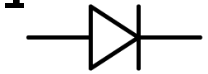
Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

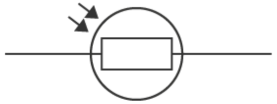
Answers: P2.10 – Electricity in the home

Connection

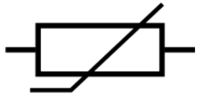
1



Diode



LDR



Thermistor

2 A thermistor decreases in resistance as the temperature of the circuit increases

3 An LDR decreases in resistance as the intensity of light on the LDR increases.

Demonstration

1 In a direct potential difference, the current is always pushed in the same direction. In an alternating potential difference, the power supply pushes the current so that it keeps on changing direction.

2 The peaks and the troughs would be about half as big (since the potential difference is about half as much) and there would be less time between them (since the frequency is higher).

3 Plastic is a good insulator of electricity. So this prevents people from receiving an electric shock.

4 It would be very dangerous to wire up a plug the wrong way round. Therefore, you need to be able to identify which wire is which very easily –even if you are colour blind.

5 A battery powered torch only uses a small p.d. and it probably doesn't have a metal case. Therefore there is a much smaller risk of harm if the user receives an electric shock –so it doesn't need an earth wire. A mains lamp, however often has a metal casing and has a high risk of harm if the user receives an electric shock –so it often has an earth wire.

6 The earth wire prevents electric shocks if the metal casing becomes live due to a fault. The earth wire provides a path of low resistance so the current will be very high. This makes sure that the fuse melts and switches off the circuit

Lesson 11: P2.11 – Transmitting Electricity

Connection

Q1. Draw the symbol of a fuse

Q2. What is the frequency and potential difference of UK mains electricity?

Q3. What is the function of the fuse?

Activation

LI: describe how electricity is transmitted using the National Grid, explain why electrical power is transmitted at high potential differences, understand the role of transformers

1. https://www.youtube.com/watch?v=Mm5khEUIBx0
2. Make a note of the title and the LO
3. Read pages 68-69
4. Draw and label figure 2.39
5. P2 DART
6. Define “Transformer” using the glossary
7. https://www.youtube.com/watch?v=EEj8hMBPTi0

Demonstration

Attempt questions 1-9
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

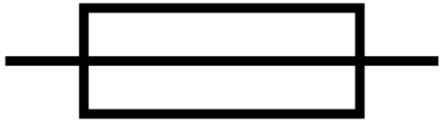
Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.11 – Transmitting Electricity

Connection

1



fuse

2 Frequency: 50Hz
Potential Difference: 230V

3 When the current gets too high, the fuse will break by melting. This will break the circuit and stop the flow of electricity.

Demonstration

1. If the local power station breaks down or it has to be switched off for maintenance then your house can still receive electrical power from other power stations.
2. “National” means that the electrical connections cover the whole country; “Grid” means that consumers are connected to many power stations rather than just one and that electrical power can be delivered by many routes.
3. A p.d. as high as this would be too dangerous. It would produce a lethal current through you if you touched it (or even if you got close to it, as it would pass through the air).
4. We are using resources to produce electricity which are running out so we need to make sure we aren’t wasting them. If lots of energy is wasted then our electricity bills would be higher as we would have to pay for the wasted energy as well.
5. This reduces the current passing through the power cables. A smaller current does not heat up the cables as much so less energy is wasted.
6. They are connected between the power cables and factories or homes.
7. When there are moving parts, the device heats up and wastes energy by transferring it to thermal energy stores. There is no friction in transformers so energy is not wasted in this way.
8. So there is only a small amount of energy wasted between the power station and the transformer.
9. There is not a complete circuit between the birds and the ground, so no current flows.

Lesson 12: P2.12 – Power and energy transfers

Connection

Q1. What is the potential difference of electricity in the national grid system?

Q2. Why is the potential difference so high in the national grid?

Q3. What is a step up transformer?

Activation

LI: describe the energy transfers in different domestic appliances, describe power as a rate of energy transfer, calculate the energy transferred

1. https://www.youtube.com/watch?v=lmQ6QvZPtj0
2. Make a note of the title and the LI
3. Read pages 70-71
4. Describe the energy transfers of a hair dryer
5. Write down the equation that links power energy and time. Include the units.
6. Write down the equation that links energy, charge and potential difference. Include the units.

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.12 – Power and energy transfers

Connection

1 400,000V
2 A high potential difference means a low current, this means that it will lose less energy as heat
3 A step up transformer increase the potential difference.

Demonstration

1 A kettle transfers energy from the mains electricity store into the thermal energy stored in the water by heating.
2a The electric current turns the motor in the drill. This means that it transfers energy from the mains electricity store into the kinetic energy stored in the drill. Energy is also transferred to the thermal energy stored in the surroundings.
2b The power of the drill = 400 W.
3 $E = Pt = 2500 \times (45 \times 60) = 6\,750\,000$ J (or 6.75 MJ)
4 $P = E / t = 10\,000 / 5 = 2000$ W (or 2 kW)
5 $E = QV = 30 \times 230 = 6900$ J
6 $V = E / Q = 1800 / 75 = 24$ V
7a Energy transferred in 5 minutes,
$E = 1150 \times 5 \times 60 = 345000$J $Q = E/V = 345\,000 / 230 = 1500$C.
7b $Q = E / V = 345\,000 / 33\,000 = 10.5$ C

Lesson 13: P2.13 – Calculating Power

Connection

Q1. What is the unit of power?

Q2. What is Ohms Law?

Q3. What is the energy transfers for a washing machine?

Activation

LI: calculate power, use power equations to solve problems, consider power ratings and changes in stored energy

1. https://www.youtube.com/watch?v=_BYxuxEIZqw
2. Make a note of the title and the LO
3. Read pages 72-73
4. Copy the equation that links power, potential difference and current. Include the units
5. Copy the equation that links power, resistance and current. Include the units
6. Use Ohms law to find the equation that links power, potential difference and resistance. Include the units.

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.13 – Calculating Power

Connection

1 Watts
2 Potential difference = Current x Resistance
3 Electrical → sound + kinetic + thermal

Demonstration

1a P = VI = 230 × 4 = 920 W
1b R= P/ I2= 920 / 42= 57.5 Ω (You could also calculate this by using R= V/ I = 230 / 4 = 57.5 Ω)
2a I= P/ V= 36 / 12 = 3 A
2b R= P/ I2= 36 / 32= 4 Ω(Again, you could calculate this by using R= V/ I= 12 / 3 = 4 Ω)
3 It could be transferred to the thermal energy stores in the kettle and the surroundings.
4a Volume = 15 × 10 × 2 = 300 m^3 Mass = density × volume = 1000 × 300 = 300 000 kg
4b Energy transferred = mcΔθ = 300 000 × 4200 × (22 -17) = 6 300 000 000 J (or 6300 MJ)
4c t= E/ P= 6 300 000 000 / 2000 = 3 150 000 s = 875 hours (over 36 days!)
5a The microwave oven transfers 800 J to the thermal energy stored in the food every second.
5b A vacuum cleaner transfers 1600 J to the kinetic energy stored by the dust, and the thermal energy stored in the surroundings every second.

Lesson 14: P2.14 – Key Concept: What's the difference between potential difference and current?

Connection

Q1. If the current flowing through a component is 2A, and the potential difference is 4V, what is the resistance of the component.

Q2. What is the power of the component?

Q3. How much energy will the component use in 4 seconds?

Activation

LI: understand and be able to apply the concepts of current and potential difference, use these concepts to explain various situations

1. https://www.youtube.com/watch?v=1xPjES-sHwg
2. Make a note of the title and the LO
3. Read pages 74-75
4. Define "potential difference", "current" and "resistance" using the glossary
5. Think of how water in a river can be used as analogy to potential difference, current and resistance. Draw a diagram that shows this analogy and label it.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P2 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-6
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: : P2.14 – Key Concept: What's the difference between potential difference and current?

Connection

1 R=V/I=4V/2A=2Ω
2 P=VI= 4V x 2A = 8W
3 E=P/t = 8W/4s = 2J

Demonstration

1. Your head is rubbing against the nylon jumper and electrons pass from one object to another. This means your head becomes oppositely charged to the jumper and there is an electric field between them. If the electric field is strong enough, the charges in the air particles get pulled apart –which creates the spark.
2. Connect two 12 V car batteries in series.
3. No –it also depends on the current that the device is able to provide.
4. The higher the p.d. (the volts) the larger the electric shock. However, the energy deposited to your body also depends on the current. So a large p.d. is safe if the current through you is very small. However, a current as large as about 0.1 A can kill you.
5. P = VI = 230 × 0.05 = 11.5 W 6 R = P / I2 = 11.5 / 0.052 = 4600 Ω

Revision P2

Connection

Q1. What is the equation for power?

Q2. What is the specific heat capacity equation?

Q3. What can a more powerful appliance do?

Activation

LI: Create a topic summary sheet

1. Fold an A3 sheet so it is divided into 8 sections
2. Look back over you lesson and group them into 8 main headings
3. Summarise the key points into each section, use keywords and diagrams and symbols rather than sentences

Consolidation

Look though the relevant past paper questions for this topic - From the P2 DIP file – see if you can complete any additional questions

Demonstration

Test yourself by working with the person sitting next to you by talking though each box on your summary sheet and seeing how many key facts you can remember

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P2.Revision

Connection

1 power = voltage x current (P=VI)
2 energy = mass x specific heat capacity x temperature change
3 Transfer more energy in a shorter period of time

P2 – National Grid

Ever since Prime Minster Stanley Baldwin promised a land of cheap and abundant electricity in 1926, we have grown ever more dependent on free-flowing power. It has become as essential to the modern world as water and sunlight were to previous ages. But with concern over climate change and Britain's nuclear power stations coming to the end of their useful life that era may be rapidly coming to an end.

In Britain's laissez-faire environment a huge range of systems were in operation, and, for many, electricity was prohibitively expensive. Keeping just five bulbs going for a day would cost a week's wages for the average person - and in 1920 only 6% of British homes were connected. By contrast France and Germany, with their interventionist states, were using almost twice as much electricity as we were.

It put pipe-smoking Conservative PM Stanley Baldwin in a quandary - he didn't want to promote nationalisation, but at the same time it was clear that electricity was too expensive not just for consumers but for industrialists. Baldwin's solution was the 1926 Electricity Supply Act, establishing a National Grid to connect the 122 most efficient power stations in the country. Initiated by the state but ultimately run by one of the very first public corporations, the Central Electricity Board, the Grid was a prime example of a very British compromise.

The first switch flicked by most homes was the light switch. For the Grid though, steep peaks in electricity usage in the mornings and evenings from electric light, and on washdays from irons, wasn't an efficient use of the system.

As Britain has become increasingly dependent on a centralised electricity system it has made us vulnerable to whoever has the power to pull the plug. Our first taste came in December 1970. Electricity supply workers began an overtime ban and working to rule. Their union thought it would take three weeks to a month before there was a serious break down in the supply of electricity. In fact, it took just 8 hours. In a chaotic week of power cuts, the army was mobilized to send emergency generators to hospitals. Bouts of shop-lifting erupted in darkened department stores and the country was brought to a standstill.

Today coal (most of it imported) generates just 28% of Britain's electricity. For decades it was nuclear that aspired to take its place, and Britain had the first commercial nuclear power station in the world in 1956 with Calder Hall. But our dogged technological nationalism came with a hefty price tag and even today the cost remains high.

Instead, in the privatised electricity industry, it was cheap North Sea gas that took King Coal's crown. Gas now generates 45% of our power, but with national reserves dwindling, there are increasing concerns over energy security. In Britain we are blessed with some of the best wind reserves in Europe, but how much of the gap can renewables really fill?

Outages have occurred before, and before wind power was a significant contributor to UK power supply. Yet Friday's incident is a reminder of the pressure under which the National Grid is being put by ever-increasing quantities of intermittent renewable energy being fed into it. When the UK's electricity was most supplied by a few large coal and nuclear power stations it was relatively easy to manage the National Grid. We knew where the power was coming from, and where it was likely to be needed. Yet with renewables management of the grid becomes a whole lot more complex. Sometimes, like yesterday, wind and solar will be rampant. At other times – such as on a calm January evening, when the demand for electricity is at its highest – they will be producing nothing. Sometimes renewables will be producing a lot of energy in one part of the country but not another. We can't store energy from a bright and windy August day for the winter, so we constantly need to be able to switch alternative, back-up power sources in and out of the grid. The possibilities for getting it wrong, causing massive power outages, increases immeasurably. At the same time, the move towards electric vehicles and domestic heating based around electric heat pumps is going to increase demand and reliance upon the electricity grid.

This is not an argument against renewable energy, which properly managed can reduce dependence on fossil fuels. We have had subsidies galore for power generators with rather less investment in the grid. It is no use generating large quantities of green power if we don't have the infrastructure to cope with it. That way lies only mass power cuts.

https://blogs.spectator.co.uk/2019/08/how-renewable-energy-makes-power-cuts-more-likely/
https://www.bbc.co.uk/news/uk-politics-11619751

Challenging

1.

a) What is the name of the Prime Minister that introduced the National Grid?

b) What percentage of homes were connected to a supply of electricity in 1920?

c) What percentage of our electricity is generate by coal and gas?

More Challenging

2.

a) What were some of the effects of the power cut in December 1970 from the article? Think of one more effect that could happen that isn't mentioned in the article.

b) What reasons are given for the national grid being inefficient?

c) Explain why a centralised electrical system is vulnerable?

Mega Challenging

3.

a) Give a summary of why it is difficult for the national grid to rely solely on renewable energy sources such as wind and solar?

b) Some politicians and activists want to ban the use of fossil fuels such as coal and oil, what would be the effects of this decision?

c) Is the author for or against using renewable energy sources? Give one piece of evidence from the article.

Answers

Challenging

1.

a) Stanley Baldwin

b) 6%

c) 28% coal +45% gas = 73%

More Challenging

2.

a) Shop-lifting in darkened department stores, Emergency generators were sent to hospitals.

Any other power cut related incident. (Traffic lights, street lights, communications)

b) Steep peaks in electricity usage in the mornings and evenings from electric light, and on washdays from irons, wasn't an efficient use of the system

c) As Britain has become increasingly dependent on a centralised electricity system it has made us vulnerable to whoever has the power to pull the plug.

Mega Challenging

3.

a) Wind and solar are unreliable. It is not always windy, and it is not always sunny. They depend upon the weather and time of year. It could be producing lots of electricity in one part of the country and none in another. It is difficult to store produced electricity.

b) Reduction in our ability to produce enough power for the nation. Power cuts could ensue along with all the effects of power cuts. There would also be a reduction in greenhouse gas emissions which would help fight climate change and global warming.

c) For: The author is not against using more renewable energy but states that we should also develop the infrastructure so that it is more capable of handling energy produced from renewable energy sources. More investment should be put into the national grid.

Against: The author gives lots and lots of risks as to the use of renewable energy sources. And how it will struggle with integrating them into the current national grid. He states that "The possibilities for getting it wrong, causing massive power outages, increases immeasurably"

Attainment Band :	P2 Electricity (AQA)
	Knowledge and Understanding
Yellow Plus/ Yellow	Explain how a person can get an electric shock and explain static electricity in terms of electric fields. Explain the concept that current is the rate of flow of charge. Rearrange and apply the equation $Q = It$. Recall that the current in a series circuit is always the same and that the total current in a parallel circuit is the sum of the currents through each branch. Explain the effect of adding more resistors to series and parallel circuits. Analyse and interpret I–V graphs for a fixed resistor. Describe applications of diodes, thermistors and LDRs and explain their uses. Use I–V graphs to determine if the characteristics of components are ohmic or non-ohmic. Explain the difference between direct and alternating potential difference. Explain the dangers of providing any connection between the live wire and earth or our bodies. Explain why electrical power is transmitted at high voltages in the National Grid. Recall and apply the equation energy transferred $E = QV$. Recall and apply the equation $P = I^2R$.
Blue	Recall that there are two types of charge and that like charges repel and unlike charges attract. Remember that charge is measured in coulombs (C) and recall and use the equation $Q = It$. Draw and recognise series and parallel circuits. Compare the brightness of lamps connected in series and parallel. Recall and apply the equation $V = I R$ and for series circuit $R_{total} = R_1 + R_2$. Draw I–V graphs for a fixed resistor. Describe the behaviour of a thermistor and LDR in terms of changes to their resistance. Explain the properties of components using I–V graphs. Recall that domestic supply in the UK is 230 V a.c. and 50 Hz. Explain why a live wire may be dangerous even when a switch in the main circuit is open. Describe how step-up and step-down transformers change the potential difference in the National Grid. Recall and use the equation energy transferred $E = Pt$. Recall and use the equation $P = V \times I$.
Green	Describe how insulating materials can become charged. Recall that an electric current is a flow of electrical charge and is measured in amperes (A). Recognise and use electric circuit symbols in circuit diagrams. Recall that the current through a component depends on the resistance of the component and the potential difference across it. Set up a circuit to investigate the relationship between V, I and R for a fixed resistor. State the main properties of a diode, thermistor and light-dependent resistor (LDR). Draw I–V graphs for a filament lamps. Recall that cells and batteries produce low-voltage direct current. Identify live, neutral and earth wires by their colour-coded insulation. Recall that the National Grid is a system of cables and transformers linking power stations to consumers. Understand that everyday electrical appliances bring about energy transfer. Recall that power is measured in watts (W) and 1 kW = 1000 W.
White	Some elements of the above have been achieved