Physics Paper 1

Model Exam Question Booklet

Physics Paper 1	
Topics in the Paper:	
P1	Energy Stores and Transfers
P5	Electricity in the Home
P6	Particle Model of Matter
P7	Radioactivity
RP14	Specific Heat Capacity
RP16	Investigating I-V Characteristics

Essential Content for the Higher Trilogy Science Exam (KSP/CPA)

This booklet is split into 3 parts:

Part 1
The first part is a selection of short response questions and answers that are likely to come in your Physics exams this summer. Spend time learning the answers to these questions, for example you could produce flash cards. You should self quiz yourself on these questions regularly!

Part 2
Selection of extended response questions (4 to 6 marks) that are likely to be on your paper this year, either because they have not been assessed in the last couple of years, or because they come up most years in exams. Prepare and practice your responses to these questions.

Part 3
Required practical section. In this section you will find step by step guidance for each practical. This is followed by a page of short response questions and answers to learn for each of the practicals. There are also some extended response questions (4 to 6 marks) that are very likely to be on the exam paper this year.

P1: Energy Conservation

Fold page here

1. What is a system?
2. What happens in terms of energy when an object is projected upwards?
3. What happens in terms of energy when a moving object hits an obstacle?
4. What happens in terms of energy when an object is accelerated by a constant force?
5. What happens in terms of energy when a vehicle is slowing down?
6. What happens in terms of energy when water is brought to the boil in an electric kettle?
7. What is the formula for kinetic energy?
8. What is the unit for kinetic energy?
9. What is the unit for mass?
10. What is the unit for speed?
11. What is the unit for elastic potential energy?
12. What is the unit for spring constant?
13. What is the unit for extension?
14. What is the formula for gravitational potential energy?
15. What is the unit for GPE?
16. What is the unit for gravitational field strength?
17. What is the unit for height?
18. What is the definition of power?
19. What formula would you use to calculate power if you had a value for energy transferred?
20. What formula would you use to calculate power if you had a value for work done?
21. What is the unit for power?
22. What is the unit for energy transferred?
23. What is the unit for time?
24. What is the unit for work done?
25. What is an energy transfer of 1 joule per second equal to?

1. Object or group of objects.
2. It gains gravitational potential energy and kinetic energy decreases.
3. The kinetic energy is transferred to heat and sound and kinetic energy of the obstacle that was hit.
4. Work is done by a force on an object. This work is converted to the object's kinetic store.
5. The kinetic energy of the vehicle decreases while energy is dissipated through heat and sound.
6. Energy transfers from the electrical store of the mains power supply to the thermal store of the water.
7. Kinetic Energy = 0.5 x mass x $(\text{speed})^2$
8. Joules, J
9. Kilograms, Kg
10. Metres per second, m/s
11. Joules, J
12. Newtons per metre, N/m
13. Metres, m
14. GPE = mass x gravitational field strength x height
15. Joules, J
16. Newtons per kilogram, N/kg
17. Metres, m
18. The rate at which energy is transferred or the rate at which work is done.
19. Power = Energy Transferred / Time
20. Power = Work Done / Time
21. Watts, W
22. Joules, J
23. Seconds, s
24. Joules, J
25. 1 watt

P5: Electricity in the Home

Fold page here

1. What is the equation that links current, potential difference and power?
2. What is the equation that links current, power and resistance?
3. What is the symbol for power?
4. What is the unit for power?
5. What is the symbol for potential difference?
6. What is the unit for potential difference?
7. What is the symbol for current?
8. What is the unit for current?
9. What is the symbol for resistance?
10. What is the unit for resistance?
11. What does the amount of energy an appliance transfers depend on?
12. When work done in a circuit?
13. What is the equation that links energy transferred, power and time?
14. What is the equation that links charge flow, energy transferred and potential difference?
15. What is the unit for energy transferred?
16. What is the unit for time?
17. What is the unit for charge flow?
18. What is the national grid?
19. What do step up transformers do?
20. What do step down transformers do?

1. Power = Potential Difference x Current
2. Power = $(\text{Current})^2$ x Resistance
3. *P*
4. Watts, W
5. *V*
6. Volts, V
7. *I*
8. Amperes, A
9. *R*
10. Ohms, Ω
11. The power of the appliance and how long it is switched on for.
12. When charge flows.
13. Energy Transferred = Power x Time
14. Energy Transferred = Charge Flow x Potential Difference
15. Joules, J
16. Seconds, s
17. Coulombs, C
18. A system of cables and transformers linking power stations to consumers.
19. Increase the potential difference from the power station to the transmission cables.
20. Decrease the potential difference for domestic use.

P6: Particles and Matter

Fold page here

1. What is the equation for density?
2. What are the units for density?
3. What are the units for mass?
4. What are the units for volume?
5. How are the particles in a solid arranged?
6. How are the particles in a liquid arranged?
7. How are the particles in a gas arranged?
8. How are changes in state different to chemical changes?
9. Which state of matter is most dense?
10. What are the names of the five state changes?
11. How do you measure the volume of a regular solid.
12. How do you measure the volume of an irregular solid.
13. How do the molecules in a gas move?
14. What happens to the speed of particles in a gas as the gas is heated?
15. What happens to pressure if the size of a container is reduced?

1. $\rho = m \div V$
2. kg/m^3
3. kg
4. m^3
5. The particles are touching and vibrate around a fixed pattern.
6. Particles are touching but not in fixed positions. They are free to flow around.
7. Particles are far apart and move around quickly and randomly.
8. The material recovers its original properties if the change is reversed.
9. Solid.
10. Melting (solid → liquid), evaporating (liquid → gas), freezing (liquid → solid), condensing (gas → liquid), sublimating (solid → gas/gas → solid).
11. Measure the length of the three sides and multiply together.
12. Place the irregular solid in water in a measuring cylinder. Measure how much the water level has gone up by.
13. In random motion.
14. The speed of the particles increases as the gas is heated.
15. The pressure would increase as particles would hit the walls of the container more often.

P7: Radioactivity

Fold page here

1. What is the basic structure of an atom?
2. Where is most of the mass of an atom concentrated?
3. How can the electron arrangements of the nucleus change?
4. Why do atoms have no overall change?
5. What is atomic number?
6. What is the mass number?
7. What is the radius of an atom?
8. What is the radius of a nucleus?
9. What is the mass of protons and neutrons?
10. What is the mass of electrons?
11. What are isotopes?
12. How do atoms form positive ions?
13. What model of the atom was developed following the discovery of the electron?
14. Describe the plum pudding model of the atom.
15. What was concluded from the alpha particle scattering experiment?
16. What model replaced the plum pudding model?
17. How did Niels Bohr adapt the nuclear model?
18. What did the experimental work of James Chadwick prove?
19. What is radioactive decay?
20. What is activity?
21. What is the unit for activity?
22. What is count rate?
23. What is an alpha particle?
24. What is a beta particle?
25. What is a gamma ray?
26. What is half life?
27. What is contamination?
28. What is irradiation?

1. A positively charged nucleus composed of protons and neutrons surrounded by negatively charged electrons.
2. Nucleus
3. The absorption of electromagnetic radiation causes electrons to move further from the nucleus. The emission of electromagnetic radiation causes electrons to move closer.
4. The number of electrons is equal to the number of protons.
5. The number of protons in the nucleus.
6. The number of protons and neutrons in an atom.
7. 0.1nm or $1x10^{-3}$m
8. $1x10^{-14}$m
9. 1
10. Negligible
11. Atoms of the same element with different numbers of neutrons.
12. They lose one or more electrons.
13. Plum pudding model.
14. Ball of positive charge with negative electrons embedded in it.
15. The mass of the atom was concentrated at the centre and that the nucleus was charged.
16. Nuclear model.
17. He suggested that electrons orbit the nucleus at specific distances.
18. The existence of neutrons in the nucleus.
19. The random process by which the nucleus gives out radiation to become stable..
20. The rate at which a source of unstable nuclei decay.
21. Becquerel, Bq
22. The number of decays recorded each second by a detector
23. A helium nucleus which is two neutrons and two protons.
24. A high-speed electron ejected from the nucleus as a neutron turns into a proton.
25. Electromagnetic radiation from the nucleus.
26. The time it takes for the number of nuclei of the isotope in a sample to half.
27. The unwanted presence of materials containing radioactive atoms on other materials.
28. The process of exposing an object to nuclear radiation. The irradiated object does not become radioactive.

Topic	P1 Energy Conservation
Qu	Describe the energy transfer for a ____.
Info	You could be asked this question for a range of scenarios including: A falling object A car driving uphill A catapult A pendulum To answer this question, you will need to do the following: Identify the input energy Identify the output energy Identify the wasted energy Describe the overall energy change
Top Tip	If you are describing energy "wasted" as heat, make sure you say where it is going – e.g., heating the surrounding air.
Model Answer	**Describe the energy transfers for a falling object** 1. *For a falling object the input energy is gravitational potential energy. As the object falls the gravitational potential energy decreases.* 2. *The gravitational potential energy is transferred into kinetic energy and so as the object falls, and the gravitational potential energy decreases the kinetic energy of the object increases.* 3. *Some of the energy is wasted as heat to the surroundings due to air resistance.* 4. *Overall, the gravitational potential energy is transferred into kinetic energy.*
Practice	1. Learn and practice the model answers above. 2. Prepare and learn model answers to describe the energy transfers for a car driving uphill, a catapult and a pendulum.

<table>
<tr><td>Topic</td><td colspan="2">P5 Electricity in the Home</td></tr>
<tr><td>Qu</td><td colspan="2">Calculating a value using the equations:
Energy Transferred = Power x Time <u>OR</u> Energy Transferred = Charge Flow x P..D</td></tr>
<tr><td>Info</td><td colspan="2">There is frequently a question in which you will need to use these formulas. Marks vary between 3 and 6 marks depending on how much processing of the information you need to do. If you need to use both formulas to answer the question this will usually be worth 6 marks.

To answer this question, you will need to do the following:
1. Check for any unit conversions you may need to do.
2. Write down the formula you will be using.
3. Substitute in the values.
4. Rearrange.
5. Do the calculation.
6. Round to the correct number of significant figures.
7. Add units.</td></tr>
<tr><td>Top Tip</td><td colspan="2">You do not need to learn these formulas as they will both be given on a data sheet this year. Always write down the formula you are using, substitute numbers and then rearrange. Avoid writing a rearranged formula as its easy to make mistakes and can lose you marks.</td></tr>
<tr><td rowspan="8">Model Answer</td><td colspan="2">Calculate the power when 1.2kJ is transferred in a minute.</td></tr>
<tr><td>1.2kJ = <u>1200J</u>
1 minute = <u>60 seconds</u></td><td>Check for unit conversions.</td></tr>
<tr><td>Energy Transferred = Power x Time</td><td>Formula to be used.</td></tr>
<tr><td>1200 = Power x 60</td><td>Substitute values.</td></tr>
<tr><td>1200 / 60 = Power</td><td>Rearrange.</td></tr>
<tr><td>Power = 20</td><td>Do the calculation</td></tr>
<tr><td>-</td><td>Round to correct number of sig fig.</td></tr>
<tr><td>20W</td><td>Answer with units</td></tr>
</table>

Topic	P5 Electricity in the Home
Qu	Calculating a value using the equations: *Energy Transferred = Power x Time* ***AND*** *Energy Transferred = Charge Flow x P..D*
Info	Sometimes you can be asked to calculate a value that would require you to use two equations. If you need to use both formulas to answer the question this will usually be worth 6 marks. In these examples we are going to be looking at using the 2 equations for energy transferred however you could need to use lots of different equations that are on your data sheet. To answer this question, you will need to do the following: 1. Check for any unit conversions you may need to do. 2. Write down the 1st formula you will be using. 3. Substitute in the values. 4. Rearrange 5. Do the maths 6. Write down the 2nd formula you will be using. 7. Substitute in the values. 8. Rearrange 9. Do the maths 10. Round to the correct number of significant figures 11. Add units to the answer.

Model Answer

Calculate the potential difference when a 2.5kW kettle that has a charge flow of 1200C is turned on for 120 seconds.

2.5kW = 2500W	Check for unit conversions.
Energy Transferred = Power x Time	1st formula to be used.
Energy Transferred = 2300 x 120	Substitute values.
-	Rearrange.
Energy Transferred = 276,000	Do the calculation
Energy Transferred = Charge x P..D	2nd formula to be used.
276,000 = 1200 x P.D	Substitute values
276,000 / 1200 = P.D	Rearrange
Potential Difference = 230	Do the calculation
-	Round to correct number of sig fig.
230V	Answer with units

Topic	P5 Electricity in the Home
Practice	Practice using the formulas for charge flow and potential difference by answering the questions below: 1. Batteries provide a potential difference of 36V and the total charge stored in the batteries is 670,000C. Calculate the maximum energy that could have been transferred from the batteries. 2. An electric bike has a battery with a potential difference of 36V and during the ride 28,000C of charge is transferred. Calculate the energy transferred by the battery in kilojoules. 3. A heater has a power of 65W. Calculate the energy transferred by the heater in 400s. 4. A 1500W heater is turned on for 5 hours. Calculate the energy transferred in this time in kJ. 5. A wind turbine supplies a power output of 9000kW for 9 seconds. Calculate the energy transferred by the wind turbine in kJ. 6. An electric bike has a motor that transfers 1800J of energy over 15 seconds. Calculate the power of the bikes motor.
Multi Step Practice	Practice using the formulas as part of a multistep question by answering the questions below. Some of the questions may need you to use other formulas (such as the ones for power): 1. Calculate the charge flow for when a 12V bulb is turned on for 25 seconds and has 25W of power. (5 marks) 2. Calculate the charge flow for when a 12V bulb is turned on for 1 minute and has 25W of power. (5 marks) 3. When the charger is connected to the battery, the potential difference across the battery is 15.0 V. The total energy stored when the battery is fully charged is 0.81 MJ. The average current used to charge the battery is 3.00 A. Calculate the time taken to fully charge the battery. 4. Calculate the potential difference when a 0.8W RAIO that has a charge flow of 5520C is turned on for 10 minutes.

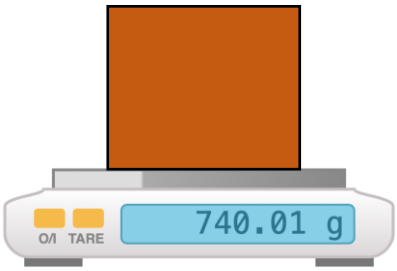
Topic	P6 Particles and Matter
Qu	Identify and explain the properties of _____
Info	You could be asked this question for solids, liquids and gases. To answer this question, you need to: 1. Describe its shape and if it can flow 2. Link the state of matters shape and ability to flow to the forces of attraction between the particles. 3. Describe its density and if it can be squashed or compressed. 4. Link the density and ability to be compressed of the state of matter to the closeness of the particles.
Top Tip	Link the properties of the states of matter to the arrangement of particles.
Model Answer	**Identify and explain the properties of a gas.** *1. A gas can flow and will completely fill a container that they are in.* *2. This is because there are very little forces of attraction between the molecules and so they are able to move freely.* *3. A gas has a very low density and can be squashed and compressed.* *4. This is because the particles are very far apart and so there is lots of space between them.*
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to identify and explain the properties of solids and gases.

Topic	P7 Radioactivity
Qu	Explain how the properties of ____ radiation affect the level of hazard at different distances.
Info	You could be asked this question alpha, beta or gamma radiation. To answer this question, you need to: 1. Describe how penetrating the radiation is 2. Describe the range of radiation. 3. Describe the ionising power of radiation. 4. Describe the risk at a short range and give a reason why 5. Describe the risk at a long range and give a reason why
Top Tip	The examiner may not use the key terms alpha, beta or gamma but use the symbols α ,β, γ watch out for this. Be clear in your work how far the radiation can travel and what materials it is unable to penetrate.
Model Answer	**Explain how the properties of alpha radiation affect the level of hazard at different distances.** 1. Alpha radiation is the least penetrating and is unable to pass through a sheet of paper. 2. It also has the least range in air and can only travel 5cm through the air. 3. Alpha radiation is the most ionising. 4. At a short range alpha radiation is very dangerous because of how ionising it is. 5. At a long range alpha radiation is not dangerous because it does not have a long range.
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to explain how dangerous beta and gamma radiation are at different distances.

RP14 Specific Heat Capacity

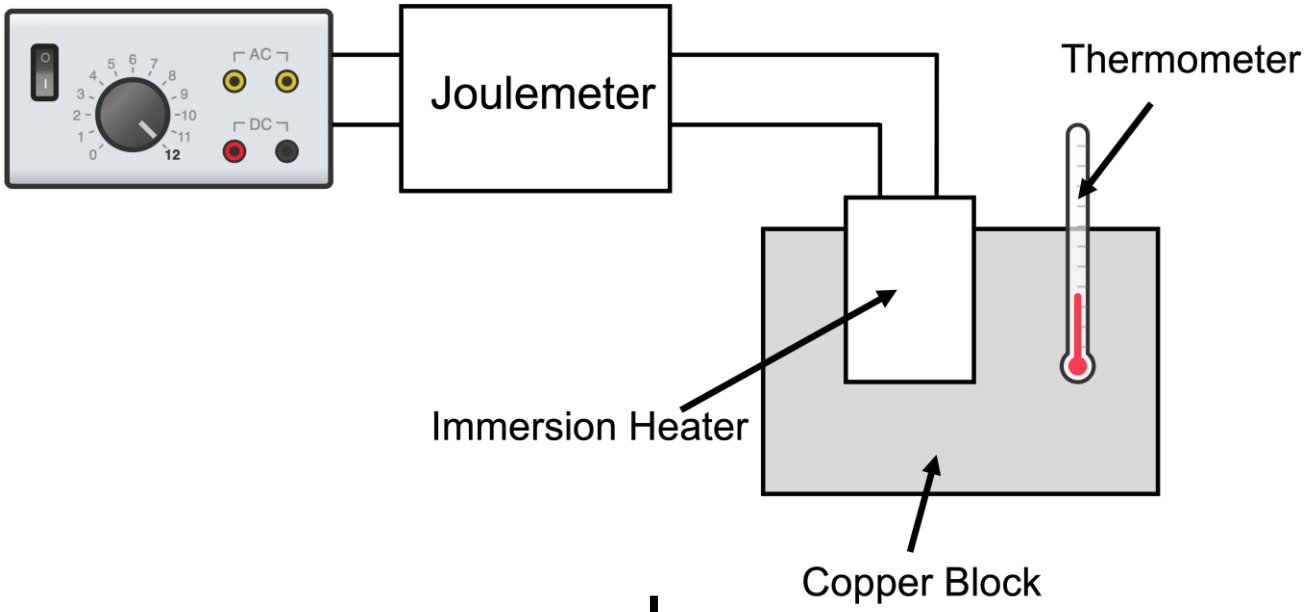
1

Measure and record the mass of the metal block



2

Set up the equipment as shown in the diagram below.



3

Record the start temperature, turn the power pack on and start the timer.

4

Record the temperature and energy transferred after 10 minutes.

5

Calculate the temperature change.

6

Use the mass, temperature change and energy transferred to calculate specific heat capacity.

RP14: Specific Heat Capacity

Fold page here

1. What piece of equipment do you use to measure mass?	1. Balance
2. What piece of equipment do you use to measure temperature?	2. Thermometer
3. What piece of equipment do you use to make the energy transferred?	3. Joulemeter
4. What piece of equipment do you use to heat a metal block?	4. Heater
5. What piece of equipment do you use to measure time?	5. Stopwatch
6. What unit is energy transferred measured in?	6. Joules
7. What unit is temperature measured in?	7. °C
8. What unit is mass measured in?	8. Kilograms
9. Why may the result you obtain for specific heat capacity be different to the true value?	9. Heat loss, turned off power supply too early, incorrectly measured mass of substance, incorrectly measured temperature, incorrectly measured energy transferred.
10. Why should the material the SHC is being determined for be insulated?	10. Prevents heat loss and so the specific heat capacity will be more accurate.
11. When determining SHC of a material what variables should be controlled?	11. Mass of the block, dimensions of the block, material of the block, current through heater, thickness of insulation, material of insulation, starting temperature and time interval.
12. What is specific heat capacity?	12. The amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.
13. What could be used to insulate the metal block?	13. Bubble wrap, cotton wool.
14. What measurements do you need when calculating specific heat capacity?	14. Mass, temperature change, energy supplied.
15. What piece of equipment do we use as a power supply when determining SHC?	15. Powerpack
16. What voltage should a powerpack be set to when determining SHC?	16. 12V
17. What are the possible risks when using the heater?	17. Burns.

Topic	RP14 Specific Heat Capacity
Qu	Explain how to determine the specific heat capacity of _____.
Info	You could be asked this question for different metals and liquids. Some that have come up in the past include: • Copper Block • Oil To answer this question, you will need to do the following: 1. Describe how to set up equipment. 2. Identify the measurements you will make 3. Identify control variables. 4. Describe how you will use your results.
Top Tip	**Use the formula for specific heat capacity on the data sheet you have been given for your writing frame.**
Model Answer	**Explain how to determine the specific heat capacity of an iron block.** 1. *Measure the mass of the block by using a balance.* 2. *Add a heater to the block and connect this to a powerpack that is connected to a joulemeter.* 3. *Add a thermometer and record the start temperature.* 4. *Turn the powerpack on.* 5. *After 10 minutes turn the powerpack off, record the energy transferred and the temperature.* 6. *Calculate specific heat capacity of the block using formula* change in thermal energy = mass × specific heat capacity × temperature change 7. Control the material and thickness of the insulation wrapped around the block.
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to explain how to determine the specific heat capacity of a copper block and a beaker of oil.

Topic	P2 Energy Transfer
Qu	Describe an experiment to find the specific heat capacity of a metal. What are the control variables when finding specific heat capacity of a metal? Explain why the metal should be wrapped in wool when finding SHC
Info	At least one of these questions is likely to come up. The examiner is going to be looking for a clear answer written in a logical sequence.
Top Tip	Be careful that you use key words/phrases accurately (these are in bold in your model answers below).
Model Answer	**Describe an experiment the student could do to measure the specific heat capacity of a metal.** *Measure the mass of metal using a balance. Use an immersion heater to heat the block and fully insulate the block by wrapping it in cotton wool. Record the start temperature of the block and connect the heater to the power supply. Use an energy meter (joulemeter) to measure the energy supplied to the block as it is warmed. Once you have finished warming the block record the energy supplied and the change in temperature Now that you have the mass, temperature change and energy transferred use these values to calculate specific heat capacity.*
Model Answer	**What are the control variables when finding the specific heat capacity of a metal?** The control variables when determining the specific heat capacity of a metal include the mass of the block, the size of the block and the material of the block. Other control variables include the thickness and material of the insulation as well as the starting temperature of the block, time the block is heated for and the current through the heater.
Model Answer	**Explain why the metal should be wrapped in wool when finding SHC** The wool acts as an insulator and prevents the loss of heat. This would lead to a much more accurate value for specific heat capacity. Without insulation the specific heat capacity value that you would find would be bigger.
Practice	1. Learn and practice the model answers above.

RP16 Investigating IV Characteristics

Investigating IV Characteristics of a Resistor

1
Set up equipment as shown in the diagram.

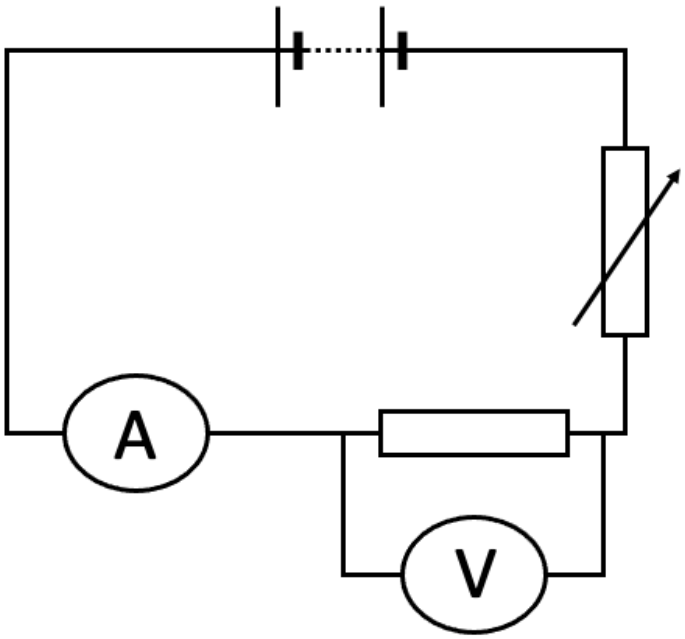
2
Record the current and voltage.

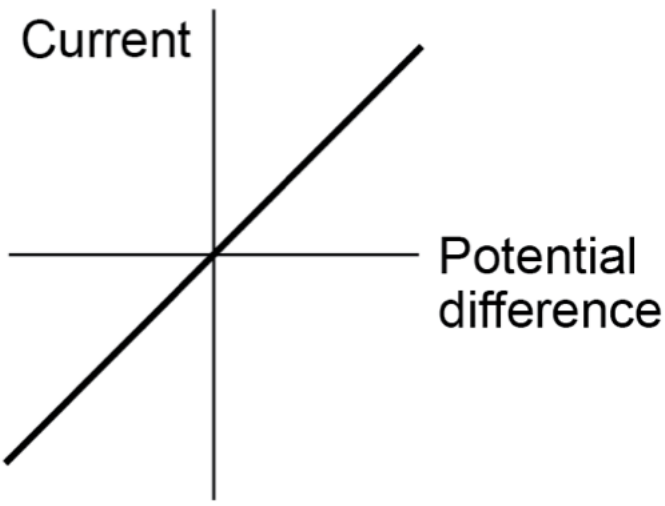
3
Adjust the variable resistor 4 more times recording the new current and voltage each time.

4
Swap the leads on the battery so that the reading on the ammeter and voltmeter is negative.

5
Record the current and voltage 5 times adjusting the variable resistor between each reading.

6
Plot a graph of current against potential difference.





RP16 Investigating IV Characteristics

Investigating IV Characteristics of a Lamp

1
Set up equipment as shown in the diagram.

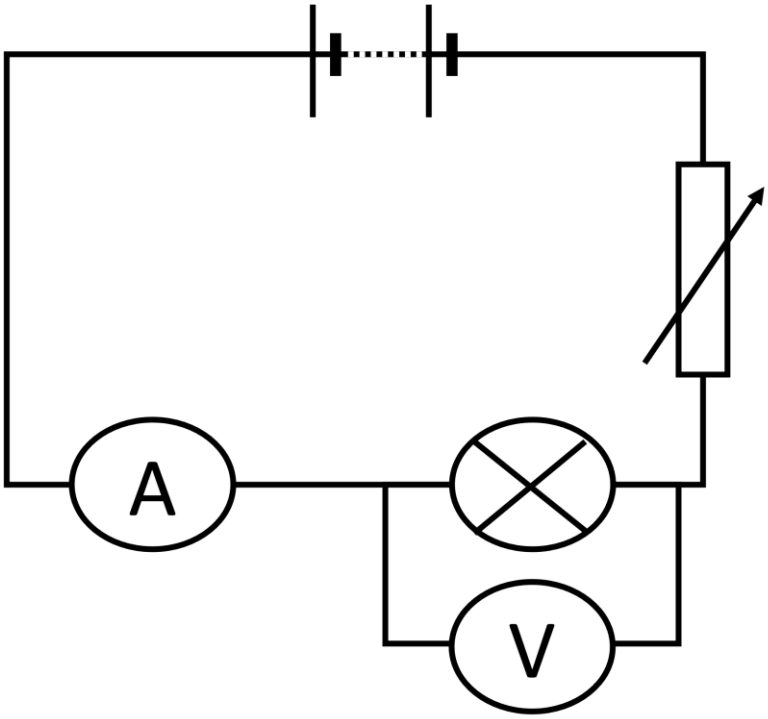
2
Record the current and voltage.

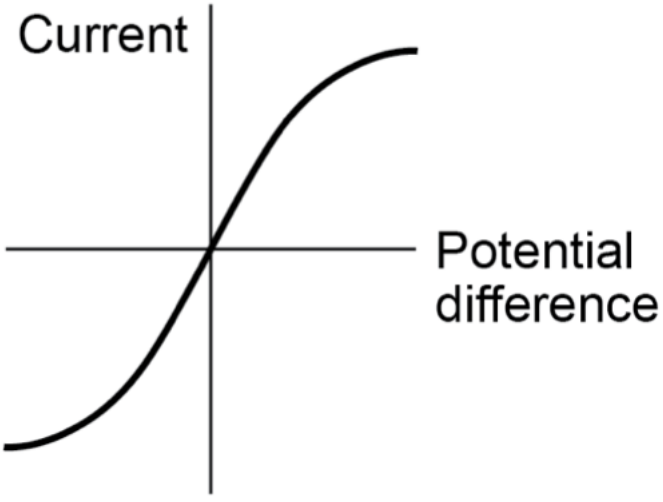
3
Adjust the variable resistor 4 more times recording the new current and voltage each time.

4
Swap the leads on the battery so that the reading on the ammeter and voltmeter is negative.

5
Record the current and voltage 5 times adjusting the variable resistor between each reading.

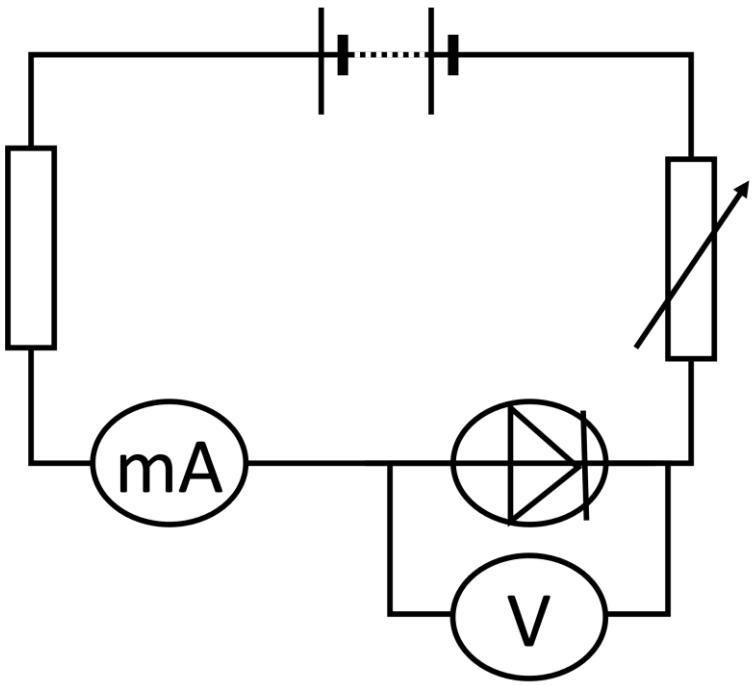
6
Plot a graph of current against potential difference.





Investigating IV Characteristics of a Diode

1
Set up equipment as shown in the diagram with a battery no higher than 5V.

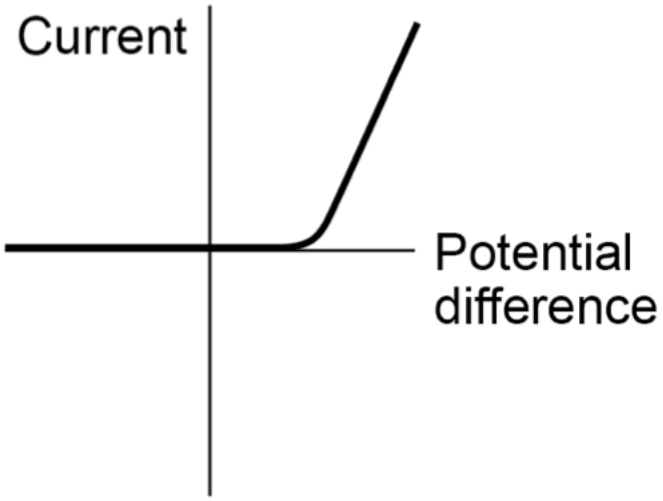


2
Record the current and voltage.

3
Adjust the variable resistor 4 more times recording the new current and voltage each time.

4
Swap the leads on the battery so that the reading on the ammeter and voltmeter is negative.

5
Record the current and voltage 5 times adjusting the variable resistor between each reading.



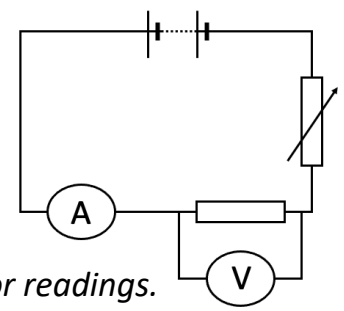
6
Plot a graph of current against potential difference.

RP16: Investigating IV Characteristics

Fold page here

1. What unit is current measured in?
2. What unit is potential difference measured in?
3. Which piece of equipment is used to measure current?
4. What piece of equipment is used to measure potential difference?
5. How should an ammeter be connected to determine the current through a component?
6. How should an voltameter be connected to determine the potential difference across a component?
7. What piece of equipment should you use to measure current when investigating the IV characteristics of a diode?
8. What should the potential difference of the power supply be when investigating IV characteristics of a diode?
9. How do you get negative current and voltage readings?
10. Why is a variable resistor used when investigating IV characteristics?
11. How many positive pairs of readings should you collect?
12. How many negative pairs of readings should you collect?
13. What do you do with your currents and voltages that have been recorded?
14. When plotting a graph of current against potential difference which goes on the X-axis?
15. When plotting a graph of current against potential difference which goes on the Y-axis?
16. How could you tell if an ammeter or voltameter have zero error.
17. When investigating IV characteristics what should be controlled?
18. How could temperature be controlled when investigating IV characteristics?

1. Amps (A)
2. Volts (V)
3. Ammeter
4. Voltmeter
5. In series
6. In parallel
7. Milliammeter
8. 5V or less
9. Swap the leads connecting the power supply.
10. To change the resistance in the circuit so that more current and voltage pairs can be determined.
11. 5
12. 5
13. Plot a graph of current against potential difference
14. Potential Difference
15. Current
16. They would show a reading when not connected in a circuit.
17. Temperature
18. Turn the power supply off between readings to prevent components warming up.

Topic	RP16 Investigating IV Characteristics
Qu	Explain how to investigate the IV characteristics of a _____
Info	You could be asked this question for different components. Some that have come up in the past include: • Resistor • Filament Lamp • Diode To answer this question, you will need to do the following: 1. Draw a diagram of how to set up equipment. 2. Identify the readings you will collect. 3. Describe what you will do with results.
Top Tip	**Be careful drawing your components. Draw the ammeter in series while a voltmeter should be connected in parallel.**
Model Answer	Explain how to investigate the IV characteristics of a _____ *1. Set up the equipment as shown in the diagram.* *2. Record the current and voltage.* *3. Adjust the variable resistor.* *4. Record the new current and voltage.* *5. Repeat this until you have 5 pairs of readings.* *6. Swap the connections to the battery.* *7. Repeat steps 3-4 until you have 5 negative pairs or readings.* *8. Draw a graph of current against potential difference.* 
Practice	1. Learn and practice the model answer above. 2. Prepare and learn model answers to explain how you would investigate the IV characteristics of diodes and filament lamps.