Applied General Assignment Brief

(Unit 2 Physics)

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| **Qualification title** | Level 3 certificate and extended certificate in applied science |
| **Unit code** | L/507/6498 |
| **Unit title** | Unit 2 Applied experimental techniques (Physics) |

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| **Learner name** |  | | |
| **Tutor/Assessor name** |  | | |
| **Assignment Title** | **Measuring resistivity and specific heat capacity** | | |
| **Date assignment issued** |  | **Submission Date** |  |

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| **Performance Criteria** | | | |
|  | **Pass** | **Merit** | **Distinction** |
| **Performance Outcome** | P7 | M7 |  |
| P8 | M8 | D5 |
| P9 | M9 | D6 |
|  | P10 |  |  |

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| **Tasks** | **Performance criteria covered** |
| Task 1 (Approximately 5 hrs) | P7, M7 |
| Task 2 (Approximately 7 hrs) | P8, M8, D5 and P 10 |
| Task 3 (Approximately 8 hrs) | P9, M9, D6 and P10 |

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| **Submission Checklist (please insert the items the learner should hand in)** | **Confirm submission** |
| Evidence of a report explaining the terms Resistivity and Specific heat capacity (SHC) in relation to material properties and explaining why it is important to know the values of these two properties(P7) |  |
| Evidence of a report describing how the values of resistivity and SHC determine the uses of materials in industry (M7) |  |
| Evidence of a report for measuring resistivity of one material including:   * standard procedure followed * Recording of data (P8) * comparison of results with industry standard data accounting for anomalies (M8) |  |
| Evidence of a report on comparison of methods used in industry (D5) |  |
| Evidence of a report for measuring SHC of one material including:   * standard procedure followed (P9) * calculating percentage error and producing a graph showing change in temperature over time (M9) |  |
| Evidence of a report explaining how this standard procedure could be adapted to measure the SHC of a material in different phase (D6) |  |
| Evidence of two risk assessments, one for each technique, of which one must be carried out by you (P10) |  |
| Witness confirmation form completed for these techniques by the tutor |  |
| **Learner - please confirm that you have proofread your submission** |  |
| **Learner Authentication**  I confirm that the work and/or the evidence I have submitted for this assignment is my own. I have referenced any sources in my evidence (such as websites, text books). I understand that if I don’t do this, it will be considered as a deliberate deception and action will be taken. | |
| **Learner Signature**  **Date** | |
| **Tutor declaration**  I confirm the learner’s work was conducted independently and under the conditions laid out by the specification. I have authenticated the learner’s work and am satisfied that the work produced is solely that of the learner. | |
| **Tutor/Assessor Signature\***  **Date** | |
| *\*Please record any assistance given to the learner beyond the group as a whole even if within the parameters of the specification* | |

**For marking purposes only**

**Marking grid**

|  |  |  |  |  |  |  |  |  |  |  |
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| **Performance Criteria (PC) Achieved** | | | | | | | | | **1stsub\*** | **Resub\*** |
| **Pass** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Merit\*\*\*** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Distinction\*\*\*** | **1st sub\***  **✓ / X\*\*** | **Resub\***  **✓ / X\*\*** | **Number of PCs achieved** | **Number**  **of PCs achieved** |
| P7 |  |  | M7 |  |  |  |  |  |  |  |
| P8 |  |  | M8 |  |  | D5 |  |  |  |  |
| P9 |  |  | M9 |  |  | D6 |  |  |  |  |
| P10 |  | **P10 to be graded only once on the unit submission form** | | | | | | |  |  |
| **Total PCs achieved:** | | | | | | | | |  |  |

***\* Sub= submission and Re-sub=Re-submission (Re-submission column to be completed only if the learner has re-submitted the assignment.***

***\*\* Achieved (✓ ) Not achieved (X). Please tick or cross for each performance criteria (PC)***

***\*\*\* Distinction and Merit criteria can be achieved only where the associated Merit and Pass criteria have been achieved first.***

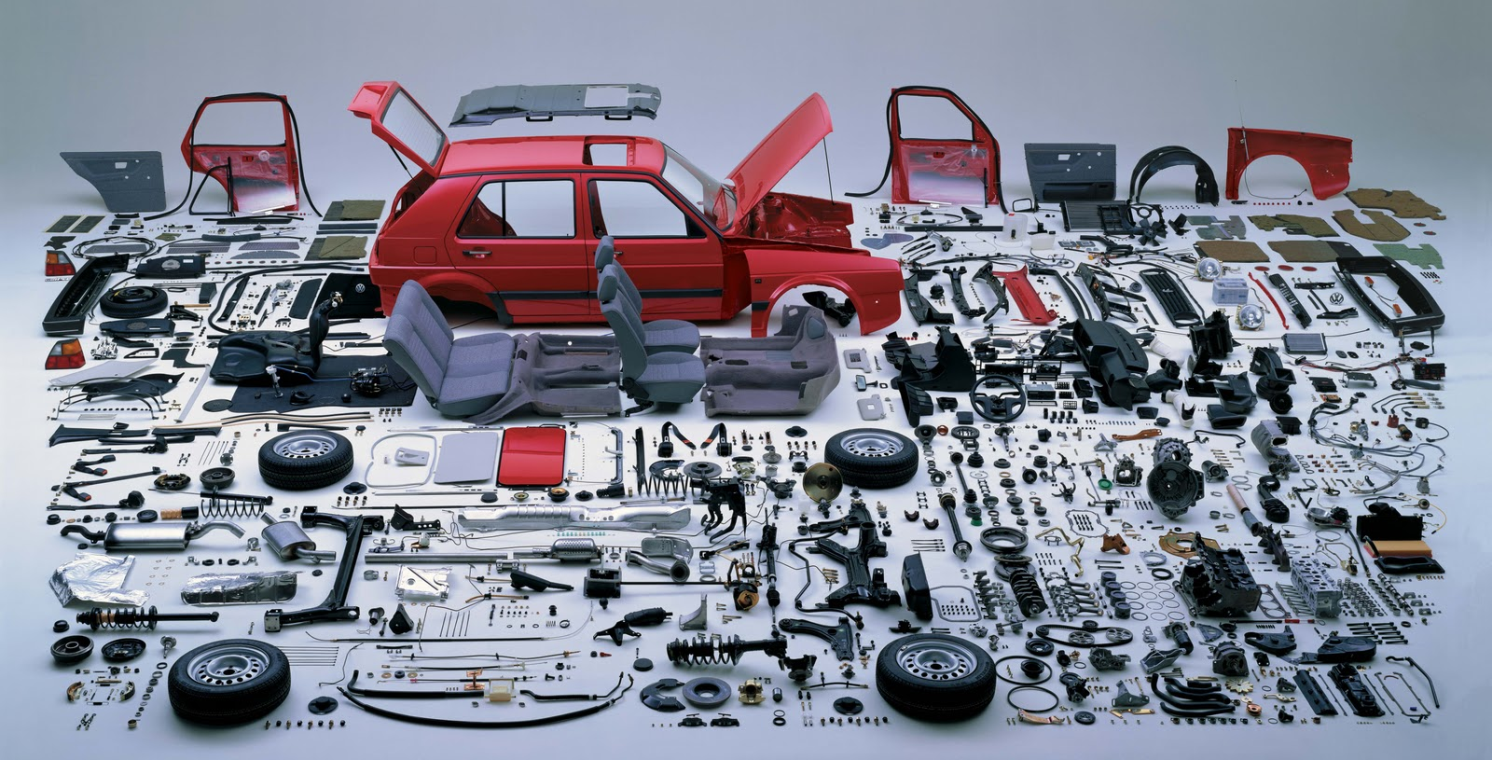
|  |
| --- |
| **Tutor summative feedback for learner**  (*Note to tutors: this section should focus on what the learner has done well. Where a learner has not achieved a specific performance criterion or is likely to want to improve on a response to a performance criterion, then you may identify the issues related to the criterion, but should not provide explicit instructions on how the learner can improve their work to achieve the outstanding criteria.)\** |
| Feedback  Tutor name(print) and date |
| Resubmission Feedback  Tutor name(print) and date |

\* All tutor notes should be deleted before the template is used.

**Scenario**

**Measuring resistivity and specific heat capacity**

You are workingas a quality control inspector in a materials laboratory associated with the automotive industry. Within this assignment you will research, investigate and report on the two techniques.

A variety of physical tests are undertaken on the materials, including resistivity and specific heat capacity. Resistivity is a way of measuring the resisting power of a particular material to the flow of an electrical current. Specific heat capacity is the heat required to raise the temperature of unit mass of a given substance by a given amount (usually 1 C).

Problems can occur when charge is lost throughout the many electric circuits present in vehicles; these circuits and are made of an assortment of materials. Additionally, heat transfer plays an important role in material selection, component operation and machinery efficiency since overheating will cause damage to various vehicle components.

Typical electric circuits include those used to power:

* lights
* alternators
* fans
* heated windscreens
* sensors
* gauges.

**Task overview**

Consideration should be given to explaining how these physical measurements relate to the selected material(s) and how such values determine their use within industry. In this case the task is set in the automotive industry

When carrying out laboratory investigations, standard procedures should be followed and results recorded. The experiments should be repeated at least three times, anomalies recognised and suitable averages taken. The Witness Confirmation form should indicate that you have carried out both physical investigations. Records should include a full account of the standard procedure, results obtained, relevant, tabulated results with calculations, and graphs as appropriate.

In addition to the above:

* results for resistivity should be compared with industry standards
* procedures should be evaluated in terms of a comparison with the methods used in industry

a graph of temperature against time for specific heat capacity should be produced and an explanation of the shape of the curve given

* an adaptation of the specific heat capacity procedure used should explain how the experiment could be adapted for a material in a different phase .

**Activities**

**Task 1**

**PO3 Demonstrate applied experimental techniques in physics**

Prior to carrying out the two standard procedures, an explanation should be given of resistivity and specific heat capacity in relation to the properties of materials **(P7)**.

Consideration should be given to the different values of resistivity and specific heat capacity that materials have.

In addition, for **M7**, how the **values** for resistivity and specific heat capacity determine the particular uses of materials in industry should be researched and an account included in your report. **Task 2**

**PO3(a) Resistivity**

**PO4 Undertake safety procedure and risk assessment when undertaking scientific practical work**

Before any practical work is started, you should complete a risk assessment. This will make you aware of any risks or hazards that are associated with the practical work you are about to do **(P10)**.

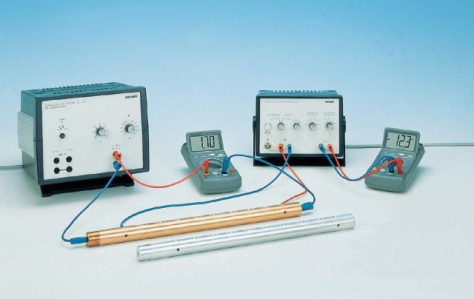
Follow a standard procedure to measure the resistivity of one material common to the automotive industry **(P8)**. e.g. Measuring electrical resistivity [tap.iop.org/electricity/resistance/112/file\_45987.doc](file:///H:\Development\Science\Support%20Material\SABs\FINAL%20SABs\tap.iop.org\electricity\resistance\112\file_45987.doc)

**NB For practical purposes, the material chosen must be a conductor in wire form.**

Ensure that:

* the procedure is strictly adhered to so that a fair replication of the results could be undertaken.
* data is presented in a suitable format and correctly recorded with due regard for precision of recording and units

**You should include the standard procedure followed in your report for this technique.**

On completion of the practical work, you should:

* draw conclusions to explain the data and calculated outcome
* compare results in resistivity with industry standard data (researched value), accounting for anomalous readings **(M8)**.

To achieve **D5**,you need to compare the methods used in industry, including a consideration of levels of accuracy and precision.

**Task 3**

**PO3 (b) Specific heat capacity**

**PO4 Undertake safety procedure and risk assessment when undertaking scientific practical work**

Before any practical work is started, you should complete a risk assessment. This will make you aware of any risks or hazards that are associated with the practical work you are about to do **(P10)**.

**Safety sheets**

[science.cleapss.org.uk/Resource-Info/Student-Safety-Sheets-ALL.aspx](file:///H:\Development\Science\Support%20Material\SABs\FINAL%20SABs\science.cleapss.org.uk\Resource-Info\Student-Safety-Sheets-ALL.aspx)

Follow a standard procedure to measure the SHC of onematerial, for instance one solid common to the automotive industry, e.g. aluminum **(P9)**. e.g <http://tap.iop.org/energy/thermal/607/file_47502.doc>

Ensure that:

* the procedure is strictly adhered to so that a fair replication of the results could be undertaken
* data is presented in a suitable format and correctly recorded
* conclusions are drawn to explain the data **(P9)**

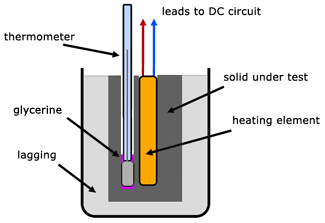
and that you make appropriate records in your laboratory workbook.

**You should include the standard procedure followed in your report for this technique.**

On completion of the practical work, you should:

* draw conclusions to explain the data and calculated outcomes
* calculate the percentage error in the results (through consideration of the precision and percentage error of each measurement taken) and use this to produce a final figure (+/-X%) for the final value of SHC
* produce and explain the graph (error bars should be drawn and used correctly) to show temperature change in the material over time
* Interpret the shape of the graph and make reference to minimising heat losses **(M9)**.

For the distinction **(D6)**, you need to explain how the standard procedure could be adapted to measure SHC for a material which is in a different phase.



**Technical notes**

**Measuring electrical resistivity**

Equipment needed:

* constantan wire of diameter 0.27 mm and 0.56 mm
* power supply, 0–12 V dc and ac, 6 A
* 2 digital multimeters
* micrometer screw gauge
* 4 mm leads
* a clip component holder

**What you need to do**

1. Set up a circuit to measure the resistance of one of your wires.

2. Estimate roughly what current is likely (you may wish to know that one metre of the thicker constantan has a resistance of the order of 2 Ω, the thinner wire about 8 Ω) and choose values of pd accordingly in order to protect your meters. You should also choose a small current so that the wire does not get hot. Such a temperature change will alter the resistivity value. Check the values with your teacher if you are unsure.

3. Measure the length of your wire and check the diameters using the micrometer screw gauge (the quoted diameters in the requirements are only nominal figures). Repeat each of these measurements several times; take the diameter at several points along the wire. Average the results.

4. Calculate the resistivity

5. Repeat steps 1–4 for the other constantan wire.

**External references**

**Institute of Physics**

This activity is taken from Advancing Physics, chapter 4, 350E.

**The specific heat capacity of water and/or aluminum**

Before starting the experiment, read through the instructions carefully.

**Purpose of the experiment**

This experiment is designed to measure the specific heat capacities of water and/or aluminum.

**You will need**

An aluminum saucepan, a 12 V immersion heater of known power, a 1kg block of aluminum, a thermometer, a 12 V power supply, a stop clock and a balance.

**What to do**

1. Water

Put 1 kg of water in the saucepan and measure its temperature. Now hold the heater in your hand and switch on the power supply. When you feel the heater getting warm put it in the water and start the stop clock. After 10 minutes switch off the power supply, stir the water and take its temperature.

2. Aluminum

Put the thermometer in the small hole in the aluminum block. Switch on the heater and when it is warm put it in the large hole in the block and start the stop clock, having recorded the initial temperature of the block. After 10 minutes switch off the power supply and take the temperature of the block.