Programme of study for Applied Science Diploma Year 13 2023-2024

Autumn (1st and 2nd term) Teacher 1, 2 and 3	Spring (1st and 2nd term) Summer (1st and 2nd term) Teacher 1	Spring (1st and 2nd term) Summer (1st and 2nd term) Teacher 2	Spring (1st and 2nd term) Summer (1st and 2nd term) Teacher 3
Other timescale: From: September 2023 To: January 2024	**Other timescale:** From: January 2024 To: May 2024	**Other timescale:** From: January 2024 To: May 2024	**Other timescale**: From: January 2024 To: May 2024
Topic: **Unit 5:** Principals of Applications of Science II. 120 marks with a total time of 2.5 hours, undertaken in three timed sessions of 50 minutes for each of Biology, Chemistry and Physics. First exam to be sat in January 2020. Diploma students to take this unit. **Skills (students should be able to do):** • Researching, reading, essay writing, exam practice. Personal learning thinking skills including: • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers, • effective participants	**Topic:** **Unit 2:** Practical Scientific Procedure and Techniques. Coursework based. Diploma and Extended Certificate students to take this unit. **Skills (students should be able to do):** • Researching, reading, essay writing, exam practice. Personal learning thinking skills including: • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers, • effective participants. The fundamental knowledge, practical skills, transferable skills – for example, organisation, self-assessment and problem-solving, and the ability to interpret data – all developed in this unit will give students confidence when they undertake the more complex practical techniques involved in higher education science courses such as biochemistry, chemistry,	**Topic:** **Unit 6:** Investigative Project. Coursework based. Diploma students only to take this unit. **Skills (students should be able to do):** • Reading, revising, essay writing, exam practice. Personal learning thinking skills including • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers, • effective participants. Students will carry out a scientific literature search and review, considering the project's aims and objectives, then produce a realistic plan and carry out the project safely using your scientific investigation skills, project management skills and what you have learnt from the other units. Finally, students will prepare an evaluative report that will consider the project outcomes and suggest amendments that may have improved	**Topic:** **Unit 12:** Diseases and Infection. Coursework based. Diploma and Extended Certificate students to take this unit. **Skills (students should be able to do):** Researching, reading, essay writing, exam practice. Personal learning thinking skills including: • independent enquirers, • creative thinkers, • reflective learners, • team workers, • self-managers

	forensic science and environmental science.	those outcomes. To complete the assessment task for within this unit, students will need to draw on learning from across your programme. Completing an investigative project is an excellent way for you to develop an understanding of the science-related workplace. The skills developed in this unit will be of considerable benefit for progression to higher education in a variety of science and science-related courses and to employment in the science or applied science sector Time management and organisation. • Adhering to and following appropriate standards and protocols. • Taking responsibility for completing tasks/procedures. • Making judgements within defined parameters. • Application of safe working practice. • Give and receive constructive feedback. • Identify, organise and use resources effectively to complete tasks. • Utilising channels of communication. • Resourceful and using initiative.	
Key Learning Outcomes (students should know): **AO1:** Students should be able to demonstrate knowledge of scientific facts, terms, definitions and scientific formulae. Command words: describe, draw, explain, identify, name, state Marks: ranges from 18 to 24 marks	**Key Learning Outcomes (students should know):** **Assignment A:** Students to undertake titration and colorimetry to determine the concentration of solutions. **Assignment B:** Students to undertake calorimetry to study cooling curves.	**Key Learning Outcomes (students should know):** **Assignment A:** Students to undertake a literature search and review to produce an investigative project proposal. **Assignment B:** Students to produce a plan for an investigative project based on the proposal.	**Key Learning Outcomes (students should know):** **Assignment A:** Students to investigate different types of diseases and infections that can affect humans. **Assignment B:** Students to examine the transmission of infectious diseases and how this can be prevented

AO2: Students should be able to demonstrate understanding of scientific concepts, procedures, processes and techniques and their application Command words: calculate, describe, draw, explain, give, show, state Marks: ranges from 51 to 60 marks **AO3:** Students should be able to analyse, interpret and evaluate scientific information to make judgements and reach conclusions Command words: analyse, comment, describe, explain, give, state Marks: ranges from 18 to 24 marks **AO4:** Students should be able to make connections, use and integrate different scientific concepts, procedures, processes or techniques Command words: calculate, comment, explain Marks: ranges from 12 to 15 marks	**Assignment C:** Students to undertake chromatographic techniques to identify components in mixtures. **Assignment D:** Students to review personal development of scientific skills for laboratory work.	**Assignment C:** Students to safely undertake the project, collecting, analysing and presenting the results. **Assignment D:** Students to review the investigative project using correct scientific principles.	**Assignment C:** Students to understand how infectious diseases can be treated and managed. **Assignment D:** Students to understand how the human body responds to diseases and infections.
End of term 1 assessment to cover: • End of chapter test on various Chemistry topics • End of chapter test on various Biology topics • End of chapter test on various Physics topics. • Mock exam to be sat in January 2020 before the real exams.	**No end of term assessment for this unit as coursework based.**	**No end of term assessment for this unit as coursework based.**	**No end of term assessment for this unit as coursework based.**
Building understanding: Rationale for your sequence of lessons: Lessons have been broken down so it is preparing students to recall, select and apply scientific knowledge and understanding to vocational and realistic situations.	**Building understanding: Rationale for your sequence of lessons:** Lessons before **assignment A** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare learners to follow instructions to safely	**Building understanding: for your sequence of lessons:** Lessons before **assignment A** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare students to be informed that when they are carrying	**Building understanding: Rationale for your sequence of lessons:** Lessons before **assignment A** given to help prepare students for this assignment to address:

Lessons will prepare students so that they will be able to use scientific terminology and concepts in given situations, and to use given information and apply appropriate mathematical and technical skills in context. Lessons will prepare students so that learners will be able to interpret and analyse information in order to make valid judgements. Lessons will prepare learners to be able to integrate relevant scientific knowledge and understanding from different areas to demonstrate a deeper understanding of how these apply to vocational and realistic situations. They will be able to use scientific terminology and concepts, communicating consistently and effectively in given situations. They will be able to select relevant information and apply appropriate mathematical and technical skills to justify decisions or solve problems in context. Lessons will prepare learners to be able to interpret and analyse information in order to make valid judgements that are supported by evidence, with awareness of limitations.	undertake titration and colorimetry. These must be performed correctly to obtain reliable and valid outcomes. Lessons will prepare learners to correctly carry out calculations of concentration. For titration, lessons will prepare learners to check the calibration of equipment used to ensure the validity of outcomes obtained (for example the calibration of a pipette, balances and a pH meter using buffer solutions.) Lesson will prepare learners to safely and correctly calibrate and use a colorimeter or visible spectrometer to determine the concentration of a coloured solution. **2) Merit**, lessons will prepare learners to undertake quantitative analytical procedures and techniques with minimal supervision, and perform to a high degree of accuracy and precision in order to obtain reliable and valid outcomes, with consideration for health and safety. Lesson will prepare learners to demonstrate skills and fluency in a number of areas, such as: calibrating pipettes transferring solids, measuring volumes, mixing solutions, carrying out titrations and making the dilutions for colorimetry standards. **3) Distinction,** lessons will prepare learners to interpret outcomes of their quantitative analytical procedures and techniques to make sound judgements on the accuracy of them. Lessons will prepare learners to be able to coherently discuss	out their search on the scientific topic, they are expected to give a comprehensive bibliography and list of references using a standard protocol, such as the Harvard system. Lessons will prepare learners to produce an appropriate research project proposal for an investigation. **2) Merit**, lessons will prepare students to show that they can use the material to help them plan their work and indicate its relevance to the investigative work they have in mind. Lessons will prepare learners to understand what a hypothesis is and to come up with a research project proposal. Lessons will prepare learners to include any potential limitations of the project proposal, such as the accuracy of any graduated apparatus or limitations of instruments/sensors. **3) Distinction,** lessons will prepare students to show that they have considered in detail, more than one appropriate investigative method of approach to tackling the hypothesis and explain why their chosen approach is suitable. Lessons will prepare learners to justify their method of approach to the method used in their project proposal, using evidence from their literature review. Lessons before **assignment B** given to help prepare students for this assignment to address: **1) Pass**, lessons prepare learners to produce a realistic working plan taking into account possible constraints.	**1) Pass**, lessons will prepare students to identify and explain the main features of the five main categories of pathogens in the unit content. Lessons will prepare learners to research and identify a named disease caused by each pathogen. Lessons will prepare learners to use their research material to explain the involvement of the pathogens in causing the infectious diseases that have been identified. The characteristics and life cycle of the pathogen for each of the five named diseases must be included in the evidence presented for assessment. Lessons to prepare learners to use Punnett squares/genetic diagrams. **2) Merit**, lessons will prepare students to choose a named infectious disease, and the effects the pathogen has on the various body systems must be considered in detail. Lessons will prepare learners to choose a non-infectious disease and assess how it affects the various body systems and its overall impact on the body. **3) Distinction,** lessons will prepare students to choose a named infectious disease and analyse how the pathogen, having entered the body, will cause infection, disruption and damage to the body systems. Lessons will prepare learners to choose a non-infectious disease and analyse the effects of this on the affected individual. Lessons will prepare learners to produce a case study for each of the diseases they have chosen.

	problems/issues with the quantitative procedures and techniques used and develop a strong rationale for suggestions made to improve accuracy and precision in order to obtain reliable and valid outcomes (or for justifying the appropriate steps already taken should no problems be identified). Lessons before **assignment B** given to help prepare students for this assignment to address: **1) Pass** lessons will prepare learners to safely check the calibration of a given thermometer, following instructions. Lessons will prepare learners to also explore the accuracy of the temperature measurements obtained from thermometers and other equipment by comparing their readings in water that is being heated. Lessons will prepare learners to use a table of their own design for recording their readings. Lessons will prepare learners to demonstrate key practical competencies in calorimetry, including being able to set up a vessel containing a solid, heating it to above its melting point, cooling it and measuring its temperature as a function of time, following a standard procedure. Lessons will prepare learners to plot graphs for a substance undergoing freezing. **2) Merit,** lessons will prepare learners to demonstrate a selection of an appropriate amount of solid; selection of a suitable vessel for heating the	**2) Merit**, lessons will prepare learners to include contingency planning (for example if they did not have enough time to complete the experiment or if a sensor/instrument stopped working). **3) Distinction**, lessons will prepare learners to reflect on their working plan and justify any changes made, such as a change in their timeline that affects milestones or internal/external factors requiring different equipment/instrumentation Lessons before **assignment C and D** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare students to assemble the apparatus/equipment effectively and efficiently, and selecting the correct materials before carrying out the experiment safely. Lessons will prepare learners to use the results of their experiment, stating if their original objectives or hypothesis has been met and making appropriate conclusions from statistical data, as well as drawing together scientific using correct principles. Lessons will prepare learners to produce their report in the correct scientific format and in a formal manner, using the information and data they have collected throughout the project. Lessons will prepare learners to outline the key skills developed in their investigative project and may identify areas of improvement.	Lessons before **assignment B** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare students to become familiar with the methods by which infectious diseases can be transmitted. Lessons will give students the opportunity to investigate this practically (swabs of surfaces, and water samples cultivated on agar plates could be used, depending on availability of equipment and health and safety regulations in centres). **2) Merit**, lessons will prepare learners to assess the methods that can be used to prevent the transmission and spread of infectious diseases. **3) Distinction**, lessons will prepare learners to extend their knowledge, having explored how infectious diseases are caused and transmitted, to include an understanding of how organisations are working to limit the spread of infectious diseases. Lessons will prepare learners to evaluate the strengths and weaknesses, and advantages and disadvantages of the methods being used and their significance in limiting the spread of disease(s). Lessons will prepare learners by choosing a named disease and providing a case study on organisations involved in preventing the spread of that disease. Lessons before **assignment C** given to help prepare students for this assignment to address:

	solid, setting up the equipment to enable heating and cooling of the vessel in an appropriate way and monitoring temperature as a function of time in a safe way. Lessons will prepare learners to demonstrate numerical skills in graph plotting when constructing their cooling curve. **3) Distinction**, lessons will prepare learners to interpret outcomes of their calorimetry to make sound judgements on accuracy. Lessons will prepare learners to be able to use appropriate mathematical terminology (for example rapid increase, decrease, approximately constant, etc.) to describe the patterns and trends in the shapes of cooling curves. Lessons will prepare learners to discuss the way in which the substance was cooled and the resulting changes to the curve and to explain why it may be necessary to make changes to procedures in order to reduce levels of uncertainty Lessons before **assignment C** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare students to follow instructions, demonstrating safe working practices and a good level of ability when carrying out paper and TLC. Lessons will prepare learners to comment on the suitability of the techniques for separation and the chromatogram produced for each technique (TLC and paper chromatography).	**2) Merit**, lessons will prepare students to run through the experimental and data analysis techniques they are using Lessons will prepare learners to refine their experimental techniques after discussion with their teacher. Lessons will prepare learners to demonstrate accuracy in their observational skills, recording the results in an appropriate format, including noting approximations, decimal point accuracy, etc. Lessons will prepare learners to justify, for example, why an approximation was used or why only two decimal points were recorded. Lessons will prepare learners to be able to state whether they are in a position to support (or not) their original hypothesis and justify their opinion based on both their collected primary data and any researched secondary data. Lessons will prepare learners to be able to succinctly interpret their statistical data and draw valid conclusions from this. Lessons will prepare learners on how to explain how specific skills developed within their project have enabled them to meet project aims. **3) Distinction,** lessons will prepare students to review the information they have obtained from their search and practical work, and decide on its validity, reliability and accuracy, and whether the original hypothesis has been met. Lessons will prepare learners to evaluate the effectiveness of their choice of statistical methods or graphs/calculations and the validity and usefulness of their research data, as well as considering how their experimental data compares to any	**1) Pass**, lessons will prepare students to identify the pathogen and the method of treating a named disease. **2) Merit**, lessons will prepare students to examine and provide detail about how and why the different treatments work and why, in some instances, they might not work. Lessons will prepare learners to refer to specific diseases and make comparisons. **3) Distinction**, lessons will prepare learners to extend their knowledge and understanding of methods of treating disease to consider the relevance and significance of the available treatments and why they may not be suitable for everyone. Lessons will prepare learners to explore and evaluate social, cultural and religious beliefs, as well as contraindications and consideration of potential side effects. Lessons before **assignment D** given to help prepare students for this assignment to address: **1) Pass**, lessons will prepare students to explain the defence systems of the body and the components and function of the specific defence system. **2) Merit**, lessons will prepare students to examine the key aspects and processes of the specific and non-specific defence mechanisms and their suitability for the purpose of defending the body. Lessons will prepare learners to include details on the speed and

	2) Merit, lessons will prepare students to demonstrate safe working practices and a high level of proficiency when carrying out paper- and thin-layer chromatography (TLC) with minimal supervision. Lessons will prepare students to produce chromatograms showing clear separation of spots, repeating the separations if they are not satisfied with the quality of the separation obtained. Lessons will prepare learners to comment on the suitability of the techniques for separation and to use appropriately calculated Rf values and consider factors that influence separation to justify conclusions drawn about the identification of components in a mixture (for example the polarity of the components of the mixtures and the polarity of the solvents and effect of the size of a molecule on its mobility). **3) Distinction,** lessons will prepare learners to articulate strong links between outcomes and techniques used in order to give a rationale for specific improvements that could be made to the chromatographic techniques. Lessons will prepare leaners to demonstrate awareness that some chromatograms may show the spots rising at an angle or have spots that are too big or smeared out rather than being distinct.	published information and discussing the limitations of their project. Lessons will prepare learners to draw on all areas of project work carried out to critically reflect on the strengths and weaknesses of their own performance and skill development, drawing on feedback. Lessons will prepare learners to demonstrate how self-reflection and feedback (which could be through collaborative working) has aided their project work, and also suggest areas for improvement and the steps necessary to achieve them.	specificity of the response to the disease. **3) Distinction**, lessons will prepare learners to consider the relevance, significance, advantages and disadvantages, and strengths and weaknesses of having a cell-mediated and a humoral response to infection caused by a pathogen.

	Lessons before **assignment D** given to help prepare students for this assignment to address: **1) Pass,** lessons will prepare students to identify areas of scientific skills developed in relation to the learning aims and will help prepare them to draw on scientific skills they have previously acquired and use them to illustrate the transferability and development of skills. **2) Merit,** lessons will prepare learners to make judgements on their skill development and level in relation to their peer group and to recognise the improvements that need to be made and how they will take steps to achieve them. **3) Distinction,** lessons will prepare learners to draw upon all areas of practical work carried out to critically reflect on strengths and weaknesses of their own performance and skill development drawing on feedback, for example from peers, teachers and industry. Drawing on others' feedback is crucial for developing balanced progression goals.		
Home – Learning: • Knowledge (flipped learning) • -6 Mark essays to be set when appropriate. • -Exam Practice • -Pupils are to read extracts prior to the lessons. • -Revision for end of topic tests.	**Home – Learning:** **Assignment A:** **A report containing:** Results for checking the calibration of a pipette and balance(s) and calibration of a pH meter. A report on the use of Na2CO3 to standardise HCl, used in turn to standardise NaOH.	**Home – Learning:** **Assignment A:** Students to produce a report or present a project plan proposal supported by a logbook. **Assignment B:** Students to produce a report or present a project plan proposal supported by a logbook.	**Home – Learning:** **Assignment A:** Students produce a report having researched a variety of infectious and non-infectious diseases, relating to their chosen diseases. The report would detail the cause and the effect the disease can have on body systems over time. The effect on the quality of life of

	pH curve from the titration plus a differential plot. Results, calculations and calibration graph for the determination of the concentration of a coloured solution using colorimetry. Explanations of how the accuracy, precision and safety of the quantitative techniques may be optimised. Observation checklist, completed by the teacher, including safety. **Assignment B:** A report containing: Results from checking the calibration of at least two types of thermometer. A table of time/temperature data and a graph of temperature against time for a substance cooling. Calculations of the rate of cooling at points on the graph. An analysis of how the rate of cooling is related to intermolecular forces and the state of the substance. A report evaluating the accuracy of the cooling curve experiment. An observation report with a checklist, completed by the teacher, including safety **Assignment C:** A report containing: Results from the paper chromatography and TLC of extracted plant pigments from paper chromatography of amino acids. An explanation of the principles behind the chromatographic separations.	**Assignment C and D:** Students to present an evaluative report of the final project outcomes. Outcomes could then be presented to a class and observation sheets could also be used to assess element of self-reflection. Alternatively, this could be an additional written piece alongside the report	the individual suffering from the disease must also be evaluated. **Assignment B:** In addition to research work, practical work and simulations should be used to ensure that learners are familiar with the methods by which infectious diseases can be transmitted. Prevention of transmission at a personal level and by organisations must be researched. A report can be produced as evidence. **Assignment C:** Research will need to be undertaken on the different methods of treating diseases. The mode of action of the treatments will need to be analysed. The accessibility or appropriateness of treatments for some people will be evaluated and reported. **Assignment D:** Reports detailing and comparing the components of the two defence mechanisms and their mode of action could be produced.

	Suggestions for improvements to the chromatographic procedures carried out and full justification of these suggestions. An observation report with a checklist, completed by the teacher, including safety. **Assignment D:** A report containing: that focuses on the evaluation of learners' performance and skill development across all scientific procedures and techniques carried out in learning aims A, B and C.		
Reading and literacy: Unit 5 revision guide students to read and make notes. Unit 5 Applied science textbook 2 Unit 5 PowerPoints for Biology, Chemistry and Physics. **Literacy: Key terms which all students will need to understand for the exam:** Understand these definitions in order to understand the question: **Add/label:** Learners label or add to a stimulus material given in the question, for example labelling a diagram or adding units to a table. **Assess:** Learners give careful consideration to all the factors or events that apply and identify which are the most important or relevant. Make a judgement on the importance of	**Reading and literacy:** Unit 2 Applied science textbook 1 Unit 2 PowerPoints Students will discuss results which will allow them to understand the progress in relation to that of others and also to gain an understanding key words such as reliability, repeatability and reproducibility of various procedures and techniques. Students will follow written scientific procedures in order to ensure accuracy by using techniques correctly and by checking that equipment – for example, pipettes, balances, pH meters and thermometers – is calibrated correctly and that appropriate standard calibration documentation has been completed.	**Reading and literacy:** Literature review • Identification of criteria, e.g. how many sources, what is the oldest date that will be looked at, which types of source will be excluded. • Nature of study, which could include field work, laboratory-based work, sports facility, workshop. • Sources of information: o identification and location of relevant and reliable sources of information, e.g. journal articles, textbooks, websites o extraction – how to obtain the information from libraries, resource centres, organisations, government organisations, charities o recognising and using protocol for referencing of information sources, to include use of the Harvard referencing system.	**Reading and literacy:** Unit 12 PowerPoints Students conduct a lot of research and reading of articles especially medical articles in order to produce a report to understand what a disease is and the causes of diseases and infections that affect humans. While non-infectious diseases caused by dietary, environmental, genetic and degenerative factors. The main focus will be on causes of infectious diseases, and their transmission, prevention and treatment. There will be the opportunity to research and understand through reading these articles the different types of pathogens and diseases they cause.

something and come to a conclusion where needed. **Calculate:** Learners obtain a numerical answer, showing relevant working. If the answer has a unit, this must be included. **Comment on:** Learners synthesise a number of variables from data/ information to form a judgement. More than two factors need to be synthesised. **Compare:** Learners look for the similarities and differences of two (or more) things. Should not require the drawing of a conclusion. Answer must relate to both (or all) things mentioned in the question. The answer must include at least one similarity and one difference. **Complete:** Learners complete a table/diagram. **Criticise:** Learners inspect a set of data, an experimental plan or a scientific statement and consider the elements. Look at the merits and/or faults of the information presented and back up judgements made. **Deduce:** Learners draw/reach conclusion(s) from the information provided. **Derive:** Learners combine two or more equations or principles to develop a new equation.		Review the investigative project using correct scientific principles: o structure and format o use of correct scientific terminology o past tense, including third person. • References and bibliography: o correctly written o included in appendix o correct use of the Harvard referencing system. Scientific evaluation of findings • Evaluation of statistical results. • Conclusions drawn from primary and secondary data using scientific principles. • Limitations of investigative project and areas for improvement. • Assessment of information sources used and relevance to investigation experimental and literature investigations. • Evaluation of proof, or otherwise, of hypothesis stated. • Recommendations for further research. Lessons will prepare students to be informed that when they are carrying out their search on the scientific topic, they are expected to give a comprehensive bibliography and list of references using a standard protocol, such as the Harvard system. Lessons will prepare learners to produce an appropriate research project proposal for an investigation. Lessons will prepare students to show that they can use the material to help them plan their work and indicate its relevance to the investigative work they have in mind. Lessons will prepare	

Describe: Learners give an account of something. Statements in the response need to be developed as they are often linked but do not need to include a justification or reason. **Determine:** Learners' answers must have an element that is quantitative from the stimulus provided, or must show how the answer can be reached quantitatively. To gain maximum marks there must be a quantitative element to the answer. **Devise:** Learners plan or invent a procedure from existing principles/ideas. **Discuss:** Learners identify the issue/situation/problem/argument that is being assessed in the question. Explore all aspects of an issue/situation/problem/argument. Investigate the issue/situation, etc. by reasoning or argument. **Draw:** Learners produce a diagram, either using a ruler or using freehand. **Evaluate:** Learners review information then bring it together to form a conclusion, drawing on evidence, including strengths, weaknesses, alternative actions, relevant data or information. Come to a supported judgement of a subject's qualities and relation to its context.		learners to understand what a hypothesis is and to come up with a research project proposal. Lessons will prepare learners to include any potential limitations of the project proposal, such as the accuracy of any graduated apparatus or limitations of instruments/sensors. Lessons will prepare students to show that they have considered in detail, more than one appropriate investigative method of approach to tackling the hypothesis and explain why their chosen approach is suitable. Lessons will prepare learners to justify their method of approach to the method used in their project proposal, using evidence from their literature review.	

Explain: Learners' explanations require a justification/ exemplification of a point. The answer must contain some element of reasoning/justification – this can include mathematical explanations. **Give/state/name:** These generally require recall of one or more pieces of information. Give a reason why When a statement has been made and the requirement is only to give the reasons why. **Identify:** Usually requires some key information to be selected from a given stimulus/resource. **Plot:** Learners produce a graph by marking points accurately on a grid from data that is provided and then drawing a line of best fit through these points. A suitable scale and appropriately labelled axes must be included if these are not provided in the question. **Predict:** Learners give an expected result. **Show that:** Learners prove that a numerical figure is as stated in the question. The answer must be to at least one more significant figure than the numerical figure in the question. **Sketch:** Learners produce a freehand drawing. For a graph this would need a line and labelled axes with important features indicated. The axes are not scaled.			

State and justify/identify and justify: When a selection is made and a justification has to be given for the selection. **State what is meant by:** When the meaning of a term is expected but there are different ways in which this meaning can be described. **Write:** When the question asks for an equation.			
Numeracy: **Chemistry:** Energy changes in industry • Know the Kelvin scale of temperature. • Know the definition of enthalpy change, ΔH = ΔU + pΔV, also called 'change in heat content'. • Know the standard conditions: o 1 × 105 Pa (100 kPa) o 298 K o per mole (mol-1). • Understand enthalpy change under standard conditions, ΔHo • Know the units of standard enthalpy change kJ mol-1. • Understand the system and surroundings. • Understand the sign convention. • Understand exothermic and endothermic reactions and processes. • Understand reaction profiles • Understand the measurement of enthalpy changes: o specific heat capacity of water o enthalpy change in water in contact with a reaction o heat Q = mcΔt	**Numeracy:** Students will have the opportunity to use problem-solving skills when they undertake calorimetry work. Students will follow written scientific procedures in order to ensure accuracy by using techniques correctly and by checking that equipment – for example, pipettes, balances, pH meters and thermometers – is calibrated correctly and that appropriate standard calibration documentation has been completed. **Assignment A:** • Use of pH meters and probes: o calibration according to the manufacturer's instructions. • Use of balances and weighing: o electronic balances – rough balances (two decimal places), analytical balances (four decimal places) o checking calibration with certified weights	**Numeracy:** **Assignment C:** Experimental procedures and techniques. Collect, collate and analyse data. Data presentation.	**Numeracy:** **Assignment A:** Genetic and degenerative disease • Genetic – inherited through DNA or DNA mutation, e.g. cystic fibrosis, sickle cell anaemia, Huntington's disease: o patterns of inheritance o recessive alleles o Punnett square

• Calculate enthalpy changes from supplied data. **Physics:** Be able to use the following quantities and units: o power, watt (W), kilowatt (kW), megawatt (MW), gigawatt (GW) o convert °C to K o pressure (Pascals (Pa), Newton per metre squared (Nm−2)). • Know the following definitions: o work done as energy transferred o work done as force × distance moved in direction of force ($W = F \times \Delta x$) o work done by a gas as pressure × change in volume of gas ($W = p \times \Delta V$) • Be able to calculate efficiency using the relationships: o efficiency = useful energy output / total energy input o for heat engines: efficiency = 1 out in Q o Maximum theoretical efficiency = 1 C H T T – • Understand the following concepts: o law of conservation of energy o ideal gas equation $pV = NkT$ o internal energy (U), first law of thermodynamics ($Q = \Delta U + W$) o isothermal and adiabatic processes o idealised engine cycles o second law of thermodynamics o heat engines, refrigerators and heat pumps o maximum theoretical coefficient of performance (COP). • Understand the changes of state of substances used in domestic and industrial processes:	o measurement of mass using increasingly accurate balances o suitable containers for weighing liquids and solids o density of water at different temperatures. • Safe use of volumetric glassware: o bulb, graduated, automated and teat pipettes o burettes o glass and plastic filter funnels o volumetric flasks o accurate dilution o use of water as a standard for calibrating volumetric glassware. Preparation and standardisation of solutions using titration Processes involved in the preparation and standardisation of solutions using titration. • Accurate determination of the end-point of titrations from: o the colour change of a suitable indicator o plots of pH versus volume o $\Delta pH/\Delta volume$ versus volume. • Calculation of concentrations: o use of molecular mass from periodic table. • Use of primary and secondary titrimetric standards. Colorimetry • Measurement and use of absorbance readings. • Use of Beer-Lambert law to determine the concentration of a transition metal ion solution. • Accurate dilution of stock solutions to prepare a range of calibration		

o transfer of energy producing temperature change or changes of state, thermal capacity, thermal equilibrium o specific heat capacity from (ΔQ = mcΔT) o specific latent heat from (ΔQ = ΔmL), fusion, vapourisation, condensation • Be able to use the following quantities and units: o density kgm−3 o tensile/compressive stress (Newton per metre squared (Nm−2)) o tensile/compressive strain (no units) o Young's modulus (Newton per metre squared (Nm−2)). • Understand the following definitions: o Density m v ρ = o tensile/compressive stress = F A o tensile/compressive strain = x L Δ o Young's modulus E = stress strain o Hooke's law F = kΔx o work done in stretching/compressing a wire/spring, Elastic strain energy, ΔE(el) = 1 2 FΔx = 1 2 k(Δx)2 **Biology:** • Understand the use of electrocardiograms (ECG), to include: o significance of PQRST points on an ECG trace. • Understand the importance of spirometer readings of lung volumes, to include: o tidal volume o inspiratory reserve volume o residual volume o expiratory reserve volume o vital capacity o total lung capacity.	standards with absorbance in the range 0 to 1. • Use of blank solutions. • Calibration plot. • Determination of unknown solution concentration from reading from graph (graph paper) or from the equation of a linear trend line through the origin (Microsoft Excel). **Assignment B:** • The relationship between temperature and heat energy. • Types of thermometer and how they are used to gain accurate readings: o electronic thermometers/temperature probes o liquid-filled thermometers. • Checking the calibration of thermometers by using ice and boiling water. • Accuracy of thermometers and temperature probes at different temperatures. Construction and interpretation of cooling curves: • temperature as a function of time • rate of cooling from the gradient of the tangent to the cooling curve • determination of melting point from the shape of a curve for a substance freezing • super cooling • shape of the curve and rate of cooling in relation to intermolecular forces and the state (solid or liquid) of the substance. **Assignment C:** Calculation of Rf value.		

• Understand the importance of the methods used to measure lung function for respiratory conditions, to include: o peak expiratory flow o forced vital capacity. • Understand the effects of exercise on the following using data from spirometer traces, to include: o tidal volume o breathing rate o respiratory minute ventilation o oxygen consumption.			
Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC): Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit. However we offer a chance during Science week and throughout the year for these students to go on visits to universities, companies visiting the school so that students can understand the purpose of this course and enhance practical skills. These visits and talks enable students to choose a career pathway for them too.	**Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):** Centres may involve employers in the delivery of this unit if there are local opportunities. It would be beneficial for an industry representative to explain the importance of the routine calibration of equipment in ensuring the reliability of results. A visit to a local laboratory would reinforce the importance of calibration of equipment and health and safety. Even if the local organisations that use science only operate on a small scale, their representatives will be able to reinforce the importance of the transferable skills this unit develops. This is usually done during Science week. The fundamental knowledge, practical skills, transferable skills – for example, organisation, self-assessment and problem-solving, and the ability to	**Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):** Completing an investigative project is an excellent way for students to develop an understanding of the science-related workplace. The skills developed in this unit will be of considerable benefit for progression to higher education in a variety of science and science-related courses and to employment in the science or applied science sector.	**Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):** A visit from the local Environmental Health Department may afford learners an opportunity to understand the role of the department in identifying pathogens and sources of infection and in preventing transmission of pathogens. They may also be able to provide information in relation to environmental diseases and their prevention. It may be possible to arrange a visit from a pharmacist/pharmacologist who will be able to discuss prophylaxis, vaccination and possible treatments for various types of pathogens. Local representatives of local and national organisations and charities may be available to provide information about initiatives in which their organisations are involved to help prevent the spread of disease. This is usually done during Science week.

	interpret data – all developed in this unit will give students confidence when they undertake the more complex practical techniques involved in higher education science courses such as biochemistry, chemistry, forensic science and environmental science		