Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications

Specification

BTEC Specialist qualifications

For first teaching September 2010

Issue 2

Edexcel, BTEC and LCCI qualifications

Edexcel, BTEC and LCCI qualifications are awarded by Pearson, the UK's largest awarding body offering academic and vocational qualifications that are globally recognised and benchmarked. For further information, please visit our qualifications website at qualifications.pearson.com. Alternatively, you can get in touch with us using the details on our contact us page at qualifications.pearson.com/contactus

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This specification is Issue 2. Key changes are listed in the summary table on the next page. We will inform centres of any changes to this issue. The latest issue can be found on the Pearson website: qualifications.pearson.com

These qualifications were previously known as:

Pearson BTEC Level 1 Awards in Mathematical Applications (QCF)

Pearson BTEC Level 2 Awards in Mathematical Applications (QCF)

The QNs remain the same.

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Summary of Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications specification Issue 2 changes

Summary of changes made between previous Issue 1 and this current Issue 2	Page number
All references to QCF have been removed throughout the specification	Throughout
Definition of TQT added	1
Definition of sizes of qualifications aligned to TQT	1
TQT value added	3
QCF references removed from unit titles and unit levels in all units	19-94
Guided learning definition updated	11

Earlier issue(s) show(s) previous changes.

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

BTEC Specialist qualification titles covered by this specification

Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications

The Qualification Number (QN) should be used by centres when they wish to seek public funding for their learners. Each unit within a qualification will also have a unit code.

Qualifications eligible and funded for post-16-year-olds can be found on the funding Hub. The Skills Funding Agency also publishes a funding catalogue that lists the qualifications available for 19+ funding.

The qualification and unit codes will appear on learners' final certification documentation.

The Qualification Numbers for the qualifications in this publication are:

Pearson BTEC Level 1 Award in Mathematical Applications	501/0265/5
Pearson BTEC Level 2 Award in Mathematical Applications	501/0264/3

These qualification titles will appear on learners' certificates. Learners need to be made aware of this when they are recruited by the centre and registered with Pearson.

Welcome to BTEC Level 1 and Level 2 Awards in Mathematical Applications

Focusing on the BTEC Level 1 Award in Mathematical Applications

This qualification enables learners to develop their skills in the mathematical applications associated with vocational roles. It has a flexible mode of delivery and it will also contribute to learners' preparation for work in a particular employment sector. Learners can progress to Pearson BTEC Level 2 Award in Mathematical Applications, Functional Skills Level 2 mathematics, or a range of sector specific Level 2 qualifications such as BTEC First Diploma, where the learner would benefit from having supporting mathematical skills.

Focusing on the BTEC Level 2 Award in Mathematical Applications

This qualification enables learners to develop their skills in the mathematical applications associated with vocational roles. It has a flexible mode of delivery and it will also contribute to learners' preparation for work in a particular employment sector. It caters for learners with different learning styles, or for those who would benefit from mathematical enrichment. The introduction to statistical calculations, analysis and interpretation are elements that could be useful to learners that may require some understanding of statistics.

Learners can progress to a range of sector specific level 2 and level 3 qualifications such as BTEC First Diploma, where the learner would benefit from having supporting mathematical skills. Learners can also progress to level 3 qualifications in mathematics such as GCE Mathematics and GCE AS Further Mathematics.

Straightforward to implement, teach and assess

Implementing BTECs couldn't be easier. They are designed to easily fit into your curriculum and can be studied independently or alongside existing qualifications, to suit the interests and aspirations of learners. The clarity of assessment makes grading learner attainment simpler.

Engaging for everyone

Learners of all abilities flourish when they can apply their own knowledge, skills and enthusiasm to a subject. BTEC qualifications make explicit the link between theoretical learning and the world of work by giving learners the opportunity to apply their research, skills and knowledge to work-related contexts and case studies. These applied and practical BTEC approaches give all learners the impetus they need to achieve and the skills they require for workplace or education progression.

Recognition

BTECs are understood and recognised by a large number of organisations in a wide range of sectors. BTEC qualifications are developed with key industry representatives and Sector Skills Councils (SSC) to ensure that they meet employer and learner needs.

All you need to get started

To help you off to a flying start, we've developed an enhanced specification that gives you all the information you need to start teaching BTEC. This includes:

- a framework of equivalencies, so you can see how this qualification compares with other Pearson vocational qualifications
- information on rules of combination, structures and quality assurance, so you can deliver the qualification with confidence
- explanations of the content's relationship with the learning outcomes
- guidance on assessment, and what the learner must produce to achieve the unit.

Don't forget that we're always here to offer curriculum and qualification updates, local training and network opportunities, advice, guidance and support.

Contents

What are BTEC Specialist qualifications?

BTEC Specialist qualifications are work-related qualifications available from Entry to Level 3 in a range of sectors. They give learners the knowledge, understanding and skills they need to prepare for employment in a specific occupational area. The qualifications also provide career development opportunities for those already in work. The qualifications may be offered as full-time or part-time courses in schools or colleges. Training centres and employers may also offer these qualifications.

Sizes of Specialist qualifications

For all regulated qualifications, Pearson specify a total number of hours that it is estimated learners will require to complete and show achievement for the qualification – this is the Total Qualification Time (TQT). The TQT value indicates the size of a qualification.

Within the TQT, Pearson identifies the number of Guided Learning Hours (GLH) that we estimate a centre delivering the qualification might provide. Guided learning means activities, such as lessons, tutorials, online instruction, supervised study and giving feedback on performance, that directly involve tutors and assessors in teaching, supervising and invigilating learners. Guided learning includes the time required for learners to complete external assessment under examination or supervised conditions.

In addition to guided learning, other required learning directed by tutors or assessors will include private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

As well as TQT and GLH, qualifications can also have a credit value – equal to one tenth of TQT, rounded to the nearest whole number.

TQT and credit values are assigned after consultation with users of the qualifications.

BTEC Specialist qualifications are generally available in the following sizes:

- Award – a qualification with a TQT value of 120 or less (equivalent to a range of 1–12 credits)
- Certificate – a qualification with a TQT value in the range of 121–369 (equivalent to a range of 13–36 credits)
- Diploma – a qualification with a TQT value of 370 or more (equivalent to 37 credits and above).

Pearson BTEC Level 1 and Level 2 Awards

The Pearson BTEC Level 1 and Level 2 Awards provide an introduction to the skills, qualities and knowledge that may be required for employment in a particular vocational sector.

Key features of the Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications

The Pearson BTEC Level 1 and Level 2 Awards in Mathematical applications have been developed to give learners the opportunity to:

- engage in learning that is relevant to them and which will provide opportunities to develop a range of skills and techniques, personal skills and attributes essential for successful performance in working life
- achieve a nationally recognised Entry, Level 1 or Level 2 vocationally-related qualification
- progress to employment in a particular vocational sector
- progress to related general and/or vocational qualifications.

Rules of combination

The rules of combination specify the credits that need to be achieved, through the completion of particular units, for the qualification to be awarded. All accredited qualifications have rules of combination.

Rules of combination for the Pearson BTEC Level 1 and Level 2 qualifications

When combining units for the Pearson BTEC Level 1 and Level 2 Award in Mathematical Applications, it is the centre's responsibility to ensure that the following rules of combination are adhered to.

Pearson BTEC Level 1 Award in Mathematical Applications

1. The Total Qualification Time (TQT) for this qualification is 90 hours.
2. The Guided Learning Hours (GLH) for this qualification is 90.
3. Qualification credit value: a minimum of 9 credits.
4. Minimum credit to be achieved at, or above, the level of the qualification: 9 credits.

All credits must be achieved from the units listed in this specification.

Pearson BTEC Level 2 Award in Mathematical Applications

1. The Total Qualification Time (TQT) for this qualification is 90 hours.
2. The Guided Learning Hours (GLH) for this qualification is 90.
3. Qualification credit value: a minimum of 9 credits.
4. Minimum credit to be achieved at, or above, the level of the qualification: 9 credits.

All credits must be achieved from the units listed in this specification.

Pearson BTEC Level 1 Award in Mathematical Applications

The Pearson BTEC Level 1 Award in Mathematical Applications is a 9 credit and 90 guided learning hour (GLH) qualification that consists of two mandatory units.

To achieve the whole qualification, a learner must successfully complete the two mandatory units. Each unit can be selected from a different vocational area.

Pearson BTEC Level 1 Award in Mathematical Applications			
Unit	**Mandatory units**	**Credit**	**Level**
1	Applications of Number, Statistics and Probability in Vocational Roles	5	1
2	Applications of Geometry, Measures, Number and Algebra in Vocational Roles	4	1

Pearson BTEC Level 2 Award in Mathematical Applications

The Pearson BTEC Level 2 Award in Mathematical Applications is a 9 credit and 90 guided learning hour (GLH) qualification that consists of two mandatory units.

To achieve the whole qualification, a learner must successfully complete the two mandatory units. Each unit can be selected from a different vocational area.

Pearson BTEC Level 2 Award in Mathematical Applications			
Unit	**Mandatory units**	**Credit**	**Level**
1	Applications of Number, Statistics and Probability in Vocational Roles	5	2
2	Applications of Geometry, Measures, Number and Algebra in Vocational Roles	4	2

Assessment

All units within these qualifications are internally assessed. The qualifications are criterion referenced, based on the achievement of all the specified learning outcomes.

Each of the units within the qualifications has specified assessment criteria and grading criteria which must be used. A summative unit grade can be awarded at pass, merit or distinction.

- To achieve a 'pass' a learner must have successfully completed **all** the assessment criteria
- To achieve a 'merit' a learner must **additionally** have successfully completed **all** the merit grading criteria
- To achieve a 'distinction' a learner must **additionally** have successfully completed **all** the distinction grading criteria.

Guidance

The purpose of assessment is to ensure that effective learning has taken place to give learners the opportunity to:

- meet the standard determined by the assessment and grading criteria and
- achieve the learning outcomes.

All the assignments created by centres should be reliable and fit for purpose, and should be built on the unit assessment and grading criteria. Assessment tasks and activities should enable learners to produce valid, sufficient and reliable evidence that relates directly to the specified criteria. Centres should enable learners to produce evidence in a variety of different forms, including performance observation, presentations and posters, along with projects, or time-constrained assessments.

Centres are encouraged to emphasise the practical application of the assessment and grading criteria, providing a realistic scenario for learners to adopt, and making maximum use of practical activities. The creation of assignments that are fit for purpose is vital to achievement and their importance cannot be over-emphasised.

The assessment and grading criteria must be clearly indicated in the assignments briefs. This gives learners focus and helps with internal verification and standardisation processes. It will also help to ensure that learner feedback is specific to the assessment criteria.

When designing assignments briefs, centres are encouraged to identify common topics and themes. A central feature of vocational assessment is that it allows for assessment to be:

- current, ie to reflect the most recent developments and issues
- local, ie to reflect the employment context of the delivering centre
- flexible to reflect learner needs, ie at a time and in a way that matches the learner's requirements so that they can demonstrate achievement.

Qualification grade

Learners who achieve the minimum eligible credit value specified by the rule of combination will achieve the qualification at pass grade.

In the Pearson BTEC Level 1 and Level 2 Specialist qualifications each unit has a credit value which specifies the number of credits that will be awarded to a learner who has achieved the learning outcomes of the unit. This has been based on:

- one credit for those learning outcomes achievable in 10 hours of learning time
- learning time being defined as the time taken by learners at the level of the unit, on average, to complete the learning outcomes of the unit to the standard determined by the assessment criteria
- the credit value of the unit remaining constant regardless of the method of assessment used or the qualification to which it contributes.

Quality assurance of centres

Pearson BTEC Level 1 and Level 2 qualifications provide a flexible structure for learners enabling programmes of varying credits and combining different levels. For the purposes of quality assurance, all individual qualifications and units are considered as a whole.

Centres delivering the Pearson BTEC Level 1 and Level 2 must be committed to ensuring the quality of the units and qualifications they deliver, through effective standardisation of assessors and verification of assessor decisions. Centre quality assurance and assessment is monitored and guaranteed by Pearson.

The Pearson quality assurance processes will involve:

- centre approval for those centres not already recognised as a centre for BTEC qualifications
- approval for the Pearson BTEC Level 1 and Level 2 qualifications and units
- **compulsory** Pearson-provided training and standardisation for internal verifiers and assessors leading to the accreditation of lead internal verifiers via the OSCA system
- quality review of the centre verification practice
- centre risk assessment by Pearson of overarching processes and quality standards
- remedial training and/or assessment sampling for centres identified through standardisation or risk assessment activities as having inadequate quality, assessment or internal verification processes.

Approval

Centres are required to declare their commitment to ensuring the quality of the programme of learning and providing appropriate assessment opportunities for learners that lead to valid and accurate assessment outcomes. In addition, centres will commit to undertaking defined training and online standardisation activities.

Centres already holding BTEC approval are able to gain qualification approval online. New centres must complete a centre approval application.

Quality Assurance Guidance

Details of quality assurance for the Pearson BTEC Level 1-2 qualifications are set out in centre guidance which is published on our website (qualifications.pearson.com).

Programme design and delivery

Mode of delivery

Pearson does not normally define the mode of delivery for Pearson BTEC Entry to Level 3 qualifications. Centres are free to offer the qualifications using any mode of delivery (such as full-time, part-time, evening only, distance learning) that meets their learners' needs. Whichever mode of delivery is used, centres must ensure that learners have appropriate access to the resources identified in the specification and to the subject specialists delivering the units. This is particularly important for learners studying for the qualification through open or distance learning.

Learners studying for the qualification on a part-time basis bring with them a wealth of experience that should be utilised to maximum effect by tutors and assessors. The use of assessment evidence drawn from learners' work environments should be encouraged. Those planning the programme should aim to enhance the vocational nature of the qualification by:

- liaising with employers to ensure a course relevant to learners' specific needs
- accessing and using non-confidential data and documents from learners' workplaces
- including sponsoring employers in the delivery of the programme and, where appropriate, in the assessment
- linking with company-based/workplace training programmes
- making full use of the variety of experience of work and life that learners bring to the programme.

Resources

Pearson BTEC Level 1 and Level 2 qualifications are designed to give learners an understanding of the skills needed for specific vocational sectors. Physical resources need to support the delivery of the programme and the assessment of the learning outcomes, and should therefore normally be of industry standard. Staff delivering programmes and conducting the assessments should be familiar with current practice and standards in the sector concerned. Centres will need to meet any specific resource requirements to gain approval from Pearson.

Where specific resources are required these have been indicated in individual units in the *Essential resources* sections.

Delivery approach

It is important that centres develop an approach to teaching and learning that supports the vocational nature of Pearson BTEC Level 1 and Level 2 qualifications and the mode of delivery. Specifications give a balance of practical skill development and knowledge requirements, some of which can be theoretical in nature. Tutors and assessors need to ensure that appropriate links are made between theory and practical application and that the knowledge base is applied to the sector. This requires the development of relevant and up-to-date teaching materials that allow learners to apply their learning to actual events and activity within the sector. Maximum use should be made of learners' experience.

Functional skills

Pearson Level 1 and Level 2 BTEC Specialist qualifications give learners opportunities to develop and apply functional skills. Functional skills are, however, not required to be achieved as part of the BTEC Specialist qualification(s) rules of combination. Functional skills are offered as stand-alone qualifications.

Access and recruitment

Pearson's policy regarding access to its qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from any barriers that restrict access and progression
- there should be equal opportunities for all wishing to access the qualifications.

Centres are required to recruit learners to BTEC qualifications with integrity. This will include ensuring that applicants have appropriate information and advice about the qualifications and that the qualification will meet their needs. Centres should take appropriate steps to assess each applicant's potential and make a professional judgement about their ability to successfully complete the programme of study and achieve the qualification. This assessment will need to take account of the support available to the learner within the centre during their programme of study and any specific support that might be necessary to allow the learner to access the assessment for the qualification. Centres should consult Pearson's policy on learners with particular requirements.

Centres will need to review the entry profile of qualifications and/or experience held by applicants, considering whether this profile shows an ability to progress to a higher level qualification.

Restrictions on learner entry

The Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications are accredited for learners aged 14 and above.

Access arrangements and special considerations

Pearson's policy on access arrangements and special considerations for BTEC and Edexcel NVQ qualifications aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the 1995 Disability Discrimination Act and the amendments to the Act) without compromising the assessment of skills, knowledge, understanding or competence.

Further details are given in the policy document *Access Arrangements and Special Considerations for BTEC and Edexcel NVQ Qualifications*, which can be found on the Pearson website (qualifications.pearson.com).

Recognition of Prior Learning

Recognition of Prior Learning (RPL) is a method of assessment (leading to the award of credit) that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and so do not need to develop through a course of learning.

Pearson encourages centres to recognise learners' previous achievements and experiences whether at work, home and at leisure, as well as in the classroom. RPL provides a route for the recognition of the achievements resulting from continuous learning.

RPL enables recognition of achievement from a range of activities using any valid assessment methodology. Provided that the assessment requirements of a given unit or qualification have been met, the use of RPL is acceptable for accrediting a unit, units or a whole qualification. Evidence of learning must be sufficient, reliable and valid.

Unit format

All units in the Pearson BTEC Level 1 and Level 2 Awards in Mathematical Applications are accredited for learners aged 14 and above.

Specialist qualifications have a standard format. The unit format is designed to give guidance on the requirements of the qualification for learners, tutors, assessors and those responsible for monitoring national standards.

Each unit has the following sections.

Unit title

This is the formal title of the unit that will appear on the learner's certificate.

Unit reference number

Each unit is assigned a unit reference number that appears with the unit title on the Register of Regulated Qualifications.

Level

All units and qualifications have a level assigned to them. The level assigned is informed by the level descriptors defined by Ofqual, the qualifications regulator.

Credit value

All units have a credit value. The minimum credit value that may be determined for a unit is one, and credits can only be awarded in whole numbers. Learners will be awarded credits for the successful completion of whole units.

Guided learning hours

Guided Learning Hours (GLH) is the number of hours that a centre delivering the qualification needs to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, for example lectures, tutorials, online instruction and supervised study.

Unit aim and purpose

The aim provides a clear summary of the purpose of the unit and is a succinct statement that summarises the learning outcomes of the unit.

Unit introduction

The unit introduction gives the reader an appreciation of the unit in the vocational setting of the qualification, as well as highlighting the focus of the unit. It gives the reader a snapshot of the unit and the key knowledge, skills and understanding gained while studying the unit. The unit introduction also highlights any links to the appropriate vocational sector by describing how the unit relates to that sector.

Learning outcomes

The learning outcomes of a unit set out what a learner is expected to know, understand or be able to do as the result of a process of learning.

Assessment and grading criteria

The assessment and grading criteria of a unit specify the standard a learner is expected to meet to demonstrate that a learning outcome, or set of learning outcomes, has been achieved. The learning outcomes and assessment and grading criteria clearly articulate the learning achievement for which the credit will be awarded at the level assigned to the unit.

Unit content

The unit content identifies the breadth of knowledge, skills and understanding needed to design and deliver a programme of learning to achieve each of the learning outcomes. This is informed by the underpinning knowledge and understanding requirements of the related National Occupational Standards (NOS), where relevant. The content provides the range of subject material for the programme of learning and specifies the skills, knowledge and understanding required for achievement of the unit.

Each learning outcome is stated in full and then the key phrases or concepts related to that learning outcome are listed in italics followed by the subsequent range of related topics.

Relationship between content and assessment and grading criteria

The learner should have the opportunity to cover all of the unit content.

It is not a requirement of the unit specification that all of the content is assessed. However, the indicative content will need to be covered in a programme of learning in order for learners to be able to meet the standard determined in the assessment and grading criteria.

Content structure and terminology

The information below shows the unit content is structured and gives the terminology used to explain the different components within the content.

- Learning outcome: this is shown in bold at the beginning of each section of content.
- Italicised sub-heading: it contains a key phrase or concept. This is content which must be covered in the delivery of the unit. Colons mark the end of an italicised sub-heading.

- Elements of content: the elements are in plain text and amplify the sub-heading. The elements must be covered in the delivery of the unit. Semi-colons mark the end of an element.
- Brackets contain amplification of content which must be covered in the delivery of the unit.
- 'eg' is a list of examples, used for indicative amplification of an element (that is, the content specified in this amplification could be covered or could be replaced by other, similar material).

Essential guidance for tutors

This section gives tutors additional guidance and amplification to aid understanding and a consistent level of delivery and assessment. It is divided into the following sections.

- *Delivery* – explains the content's relationship to the learning outcomes and offers guidance about possible approaches to delivery. This section is based on the more usual delivery modes but is not intended to rule out alternative approaches.
- *Assessment and grading* – gives amplification about the nature and type of evidence that learners need to produce in order to achieve the unit. This section should be read in conjunction with the assessment and grading criteria.
- *Essential resources* – identifies any specialist resources needed to allow learners to generate the evidence required for each unit. The centre will be asked to ensure that any requirements are in place when it seeks approval from Pearson to offer the qualification.
- *Indicative resource materials* – gives a list of learner resource material that benchmarks the level of study.

Units

Level 1 Units

Unit 1: Applications of Number, Statistics and Probability in Vocational Roles

Unit code: D/601/9135

Level: 1

Credit value: 5

Guided learning hours: 50

Unit aim

The aim of this unit is to enable learners to develop mathematical problem-solving skills in a range of different vocational roles. They will learn about using number, using discrete data to draw, and compare, charts, graphs and diagrams, and about using probability to show the likelihood of an event happening.

Unit introduction

This unit provides learners with an introduction to number, decimals, fractions and percentages, knowledge of which is essential in any work-place. The ability to use number skills to solve problems is a key requirement in a wide number of practical activities.

At first, learners will develop number skills using the four operations of addition, subtraction, multiplication and division. They will gain an understanding of the relationship between the different operations and this will enable them to perform simple calculations to solve problems relating to properties such as length, time, money, weight and mass.

The metric system is used for all measuring purposes, so it is useful for the learners to be able to convert between metric units.

Graphical representation to illustrate the relationship between variables is commonly the use of charts, bar charts and frequency tables. Learners will develop the skill of drawing conclusions from data sets, through measures of central tendency, charts and diagrams, a key element of analysing and interpreting data in a vocational role.

Learners will also learn how to use probability in real-life situations, to work out the likelihood of an event happening.

Throughout this unit, learners can be introduced to the world of work by developing their mathematical problem-solving skills through practical applications in a vocational context.

Learning outcomes

On completion of this unit a learner should:

1 be able to use number to solve routine problems in real-life contexts

2 be able to use discrete data to solve routine problems in real-life contexts

3 understand how probabilities can predict outcomes in real-life contexts

Unit content

1 Be able to use number to solve routine problems in real-life contexts

Numbers: whole numbers; decimals to two decimal places; positive and negative numbers; familiar fractions, (eg $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$ and $\frac{1}{10}$); percentages, (eg 50%, 25%, 75%, 10%); multiplying and dividing using powers of 10, (eg 10, 100, 1000)

Four operations: add; subtract; multiply; divide

Solve problems: round numbers; convert between simple fractions, decimals and percentages; convert units, (eg between metric units, lengths, areas, weights, time, money); interpret information from diagrams, (eg fraction of shaded area); calculate and use fractions and percentages of quantities and measurements, (eg distance, time and weight)

2 Be able to use discrete data to solve routine problems in real-life contexts

Statistics: interpret and draw simple charts, graphs and diagrams (eg frequency tables, bar charts and line graphs) and then a further variety (eg pie charts, two-way tables); calculate the mean, median, mode and range of discrete data-sets and compare two data-sets using the mean, median, mode or range

3 Understand how probability can predict outcomes in straightforward real-life contexts

Probability: probability scale; estimate probabilities from theoretical and experimental outcomes; effect of repeating experiments as using more data implies more reliable outcomes; list and predict outcomes for events from given probabilities

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Solve real-life problems using the four operations of addition, subtraction, multiplication and division using positive and negative whole numbers	M1 Solve real life problems using fractions and percentages	D1 Solve real-life problems using conversion of units in calculations
P2 Solve real-life problems using addition and subtraction of positive and negative decimals (up to two decimal places)		
P3 Solve real-life problems by identifying mean, median, mode and range using discrete data	M2 Compare two sets of data, in real-life contexts, using mean, median, mode and range	
P4 Draw frequency tables, bar charts and line graphs in real-life contexts	M3 Compare charts, graphs and diagrams, in P4, in real-life contexts	D2 Draw and interpret a further variety of charts, graphs and diagrams, for example pie charts and two-way tables, used in real-life contexts
P5 Use probability to predict outcomes in real-life contexts	M4 Compare outcomes for two events by showing how probabilities are found in real-life contexts	

Essential guidance for tutors

Delivery

This unit should primarily be classroom based, with a mixture of classroom teaching and practical examples. The unit will require learners to become familiar and confident with necessary skills and be able to apply these skills to solve problems, in a vocational context. Learners should be encouraged to use their mathematical knowledge in order to solve a real-life problem in a vocational context.

Learners should be introduced to the content through a chosen vocational context. These themes can be used to deliver the mathematical content, with learners solving problems, using the appropriate mathematical methods. Visits from professionals, and practical visits to locations in the selected vocational industry should be encouraged. These may be useful for developing problems that learners can solve by using their mathematical skills.

Fractions and percentages of quantities could be explored through appropriate vocational contexts. It is expected that learners will add, subtract, multiply and divide positive and negative whole numbers, fractions, percentages of quantities as well as decimals throughout this topic, without the use of a calculator. Rounding to one or two decimal places and converting units should be explored when dealing with measures in a vocational context. The learner will need to be aware of 'BIDMAS' – the order of operations when more than one operation is required to find a solution.

Learners will need to be able to calculate measures of central tendency for data sets, and should use data appropriate to the vocational industry they are investigating. Learners are to be given data sets. If they collect their own data sets, they should be supported. Learners also need to consider which charts and diagrams are the most appropriate to use with their data.

Work using probability should be regarded as introductory and should be restricted to routine theoretical and experimental probabilities of outcomes for up to two independent events. More advanced probability work, for example, the probability of more than two events occurring, or of successive or mutually exclusive events, should be left for learners progressing to Level 2.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Fractions and percentages could be explored through cost reductions in a travel agency, for example, calculating a child's fare by dividing an adult fare by 50 per cent, finding $\frac{1}{4}$ of a cost for a room sleeping four people to find the cost per person. This can be extended to looking at early booking discounts, where the discounts vary in multiples of 5 per cent, or finding percentage increase or decrease of prices in comparison to previous years. Percentages can also be used to explore the profit made by travel agencies after booking multiple parts of package holidays. Rounding to one or two decimal places could be explored when comparing journey times and the dimensions and the weights of luggage. For example, coach journeys can be recorded in hours to one decimal place, the dimensions of the luggage are recorded in centimetres or metres to two decimal places and weights of luggage can be measured in kilograms to one decimal place. Converting units can be used when calculating luggage space in a coach hold and for the time taken for multiple coach journeys.

Measures of central tendency could be explored by considering the number of visitors to a museum, or the number of holidays booked to Europe by a travel agency. Alternatively, learners could be supported to collect data themselves by surveying visitors to attractions and then using this data to make some recommendations. It may help to give learners data sets and averages and ask them to use the averages that support or contradict a statement. Comparisons using the mean, median, mode and range are expected at this stage.

Learners should use data appropriate to the travel and tourism industry when drawing and interpreting graphs. This could include data relating to climate, accommodation occupancy, the amount of money spent by visitors or place of residence of tourists.

Learners could explore basic probability in the context of theme parks, including looking at the chance of winning in a lucky dip, knocking down a coconut with a ball or winning in the shooting gallery. This could also include the outcomes of events such as the probability of coach journeys being delayed or guests choosing Continental or English breakfasts in bed and breakfast accommodation.

Sport

Fractions and percentages of quantities could be explored through training programmes for weight repetitions, for example, finding 50 per cent of the maximum weight to give the recommended weights for weight-training repetitions. This can be extended to looking at nutritional analysis, assuming that the calorific intake should consist of 55 per cent carbohydrate, 30 per cent fat and 15 per cent protein where the calorific content for 1 gram is: 4 kilocalories of carbohydrate, 8 kilocalories of fat and 4 kilocalories of protein.

Rounding to one or two decimal places could be explored when comparing race times, lengths or weights. For example, 100m race times are recorded in seconds to two decimal places, weights used are measured to one decimal place and marathon race times are measured to the nearest minute. Converting units can be used when calculating body mass index and metabolic rates (heights and mass need to be in metric units).

Measures of central tendency could be explored through analysing times of events such as marathons, 10 km races or football-team results. Data could be generated from practical class activities and then analysed.

Learners could explore routine probability using horse and car racing, where the chance of a winner out of ten competitors is $\frac{1}{10}$ or 10 per cent. This could also include the outcomes of events such as the FA Cup, the Wimbledon Tennis Championship, the Rugby World Cup, the Ashes Cricket Test or a football league.

Engineering

Fractions and percentages of quantities could be explored through calculating percentage waste values from production lines, for example, finding 10 per cent of the total number of items produced. This can be extended to looking at CABBAGE, where the percentage or fractional amount of waste material from a production line can be used to create another product. Percentages can also be used to explore the efficiency of machinery, including percentage increases and decreases when increasing and decreasing particular variables.

Rounding to one or two decimal places could be explored when measuring lengths, mass, force or time, for example, forces are measured to one decimal place, lengths to two decimal places and time to one decimal place. Converting units can be used when calculating the total amount of materials needed, or length of time needed, to produce an item.

Measures of central tendency could be explored through analysing mean time between failure rates for different pieces of machinery. Data can be generated, and then analysed, from practical investigations of lengths of simple components cut from stock lengths.

Learners could explore routine probability by investigating the quality of items produced on a production line, for example, by investigating the chance of a light bulb being faulty is $\frac{1}{10}$ or 10 per cent. This could also include the outcomes of events such as battery failure, bearing failure rates or the malfunction of machinery.

Health and Social Care

Basic number skills, fractions and percentages of quantities could be explored, for example, through calculating the cost of day care. For example, calculating the cost of a child who stays in the nursery for half a day compared to a full day, or calculating the percentage of the sessions available, or calculating the percentage of the total cost the carer would have to pay if the child were entitled to five free sessions under a government childcare scheme. This could be extended to consider discounts for more than one child from a family. Percentages can also be used to calculate the uptake of immunisations.

Rounding to one or two decimal places could be explored when considering weight in kilograms and grams or height in metres and centimetres. For example, weight can be recorded in kilograms to one decimal place and height in metres to two decimal places. Converting units can be used when calculating body mass index (BMI), where height and weight need to be in metric units. Learners could also consider access to nursery service providers, and use this information to calculate the distance from home to the nursery, converting units in the process.

Measures of central tendency could be explored by investigating the uptake of immunisations or the incidence of disease. Alternatively, learners could collect data themselves by undertaking a small piece of research into lifestyle choices. This would give them the opportunity to consider data collection methods, and they could use the data they collect to calculate mean, median and mode, as well as displaying data by using the appropriate charts, graphs and diagrams. Investigating physical measures of health, for example, resting pulse, pulse after exercise and recovery rates, BMI and peak-flow readings, would provide learners with the opportunity to collect analyse and display their own data sets.

Learners could explore routine probability related to incidence of disease, including the probability of developing a life threatening disease from long term smoking, or listing meal choices to solve simple catering problems at a nursery.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • introduction to unit content, scheme of work and assessment strategy • tutor-led revision of the four operations of addition, subtraction, multiplication and division to solve number problems, using positive and negative numbers whole numbers • tutor-led revision of addition and subtraction of positive and negative decimal numbers (up to 2 decimal places) to solve number problems • explain and apply BIDMAS rule to solve number problems • tutor-led revision of the use of an electronic scientific calculator Individual learner activity: • tasks and activities using positive and negative whole numbers and decimals (up to two decimal places), without the use of an electronic scientific calculator • tasks and activities in using positive and negative whole numbers and decimals (up to two decimal places), with the use of an electronic scientific calculator Whole class teaching: • explain how to use fractions and percentages, without and then with, an electronic scientific calculator • explain rounding to one or two decimal places • explain converting units Individual learner activity • tasks and activities using fractions and percentages, without and then with an electronic scientific calculator • tasks and activities using rounding to one or two decimal place • tasks and activities using converting units
Prepare for and carry out assignment 1 (P1, P2, M1, D1)

Topic and suggested assignments/activities and/assessment
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • explain mean, median, mode and range using discrete data • explain how to compare mean, median, mode and range of two data sets • tutor demonstration of representing discrete data by using frequency tables, bar charts, line graphs, pie charts and two-way tables • tutor demonstration of how to compare and interpret frequency tables, bar charts, line graphs, pie charts and two-way tables for two data sets Individual learner activity: • tasks and activities finding, and comparing, mean, median, mode and range using discrete data • tasks and activities representing discrete data • tasks and activities representing, comparing and interpreting two data sets, using discrete data
Prepare for and carry out assignment 2 (P3, P4, M2, M3, D2)
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • explain probability in terms of events, outcomes and likelihood • explain how probability can be used to compare two events Individual learner activity: • tasks and activities using probability to list outcomes tasks and activities using probability to compare two events
Prepare for and carry out assignment 3 (P5, M4)

Assessment

Assessment should be presented in the form of a portfolio where learners have clearly demonstrated their skills and understanding. Learners should choose the number skills and the statistics that they think is most appropriate to solve the problems they are presented with. Due to the vocational nature of this course, early consideration should be given to the activities and tasks learners are to complete. These should be based on the chosen vocational industry and should allow learners to progress from pass to distinction level by varying the skills used.

In order to achieve P1, learners should show that they can use the four operations (add, subtract, multiply and divide) for positive and negative whole numbers. As a minimum they should add and subtract once each with 2-digit numbers and 3-digit numbers, multiply 2-digit numbers by 1-digit numbers and 3-digit numbers by 2-digit numbers and divide 2-digit numbers and 3-digit numbers by 1-digit numbers and 2-digit numbers. Learners should perform each operation at least twice, and one of these operations must include a negative number.

For P2, learners should add and subtract positive and negative decimals (to two decimal places). Learners should be able to do this without a calculator, showing their working as they go. Learners should perform each operation at least twice, and one of these operations must include a negative number.

To achieve P3, learners should be able to calculate the mean, median, mode and range of a set of discrete data, whether in list form or in a table.

In P4, learners are required to draw simple charts, graphs and diagrams. They should be able to draw line graphs, frequency tables and bar charts to display data from a practical situation within a vocational industry. Learners should display data for at least two situations and draw each type of chart, graph or diagram once for each situation. Data should be appropriate to the methods of display. Data that is appropriate to type of chart, graph or diagram required should be provided for the learner.

In order to achieve P5, learners are required to use probability to predict the possible outcomes relating to a routine situation within a vocational industry.

To achieve M1, learners are required to demonstrate that they can calculate fractions of quantities, without the use of a calculator. Learners are expected to show that they can calculate percentages of quantities, without the use of a calculator, and to use these to solve non-routine problems within real-life contexts. These can include calculating percentages of quantities and simple percentage increases and decreases. Learners should show that they can calculate a fraction of a quantity and a percentage of a quantity at least three times in a problem, and complete at least two problems.

To achieve M2, learners must compare two sets of data using the mean, median, mode and range, and be able to write a comparison of two data sets within a vocational context.

To achieve M3, learners are required to interpret simple charts, graphs and diagrams that they have drawn for P4.

To achieve M4, learners must compare outcomes for two events and show how the probabilities are found. Learners should consider at least two situations, comparing the probabilities of two events in each real-life situation.

In order to achieve D1, learners should be able to convert between units of measurement, for example, between millimetres, centimetres, metres and kilometres, grams and kilograms, pounds and pence, seconds, minutes and hours. They need to be able to demonstrate that they can convert between these units at least twice in a real-life problem and learners need to complete at least two problems. In each problem, learners should use the appropriate units of measure to complete a calculation that requires at least two operations.

In order to achieve D2, learners need to be able to draw and interpret pie charts and two-way tables. Learners must show that they can draw each diagram at least once for each data set and should work with at least three data sets. These data sets could be based on results from practical investigations in a vocational industry. Data that is appropriate to the type of chart, graph or diagram required should be provided for the learner.

The following are a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Investigation into two coach companies, with graphs to display their data, designing a funfair, ensuring that the probability of winning on attractions still allows for a profit to be made, and analysing hotel accommodation, including average customer satisfaction levels.

Investigate the cost of holidays, for example by calculating the cost per person for a party of four guests on a holiday being coordinated by a travel agency. Percentages and fractions could include calculating the discounts offered by various travel and tourism agencies, for example, calculating the cost of a package holiday with a $\frac{1}{3}$ off. Percentage tasks could include calculating VAT for holiday bookings. Tasks could also involve calculating the increased or decreased cost of a holiday from one holiday season to the next. Work on the conversion of units could be included in tasks involving measures, for example, this could include the design of the layout of a travel agency's window, where the lengths given in the task are in different units.

Learners could use data sets from accommodation agencies and, for example, occupancy rates could be calculated using the mean and the range of guests per night over a period of time. Learners could use data sets from accommodation agencies to calculate the mean number of guests per month or the mean for a particular length of stay in a range of holiday destinations.

Charts to display the number of customers visiting a holiday attraction over a set period, the number of customers buying insurance when booking a holiday in a travel agency and the amount of money spent by visitors. Data can be obtained from **www.staruk.com** as well as from local tourist boards, local authority tourist departments and their websites. Charts, graphs and diagrams can be drawn from using data sets from the travel and tourism industry. Examples could include the number of flights from different UK airports taken from a brochure or travel agency sales. These data sets could be based on the results from customer satisfaction surveys or the average attendance figures for museums and funfairs at different times of the year.

The list of possible outcomes for choosing a holiday destination could include investigating of where two families choose to go on holiday from a selection of four resorts. Learners could calculate the probability of snow falling in a particular ski resort based on the previous year's data, or how airlines oversell seats on busy flights by using the probability that not all the passengers will turn up for the flight.

Sport

Investigations could include a comparison of the results of different football teams, using graphs to display data, the analysis of nutritional value in calorific intake with regards to basic metabolic rate or body mass index, and designing a fitness training programme, using the basic metabolic rate in a range of activities and the times of these activities, for example, investigating a programme of weight repetitions.

An investigation of body composition could involve using the four operations of addition, subtraction, multiplication and division. Calculations with fractions and percentages could include calculating the amount of fat, carbohydrate and protein (in grams) of 200 grams of yoghurt, using information on the yoghurt pot of its nutritional content. Learners could calculate the percentage of fat lost, and the percentage of muscle gained, from body composition analysis. Work on the conversion of units could be included in tasks involving measures, for example, this could include designing a fitness programme which covers a range of distances and weights, where the measures given in the task are in different units.

Learners could use data sets which give the results of sporting events, for example, the mean goals per match in different football leagues, the mean strokes per length of a swimming pool using the different styles in swimming galas or the mean strokes per hole in a round of golf. Data sets could include results from a football league and the average attendance figures for football matches in different seasons or for clubs from different leagues. Charts, graphs and diagrams could be explored through investigating body composition, by drawing graphs of the proportions of the elements of different body types, by displaying and analysing world record results or outcomes of particular sporting events. Pie charts and two-way tables could be drawn using data sets from the sports industry such as matches played in various divisions on a Saturday or the gender balance in the attendance at a major event at various times of the year. The data used could be based on results from national data sets and from real attendance figures.

Learners should base probability work on sports industry situations, for example they could explain how pit teams decide to use 'wet' or 'dry' tyres in a Formula One race. Learners could list the possible outcomes from a knockout competition in a particular sport.

Engineering

Investigations could include a comparison of time between failure rates, with graphs to display the data, an analysis of the amount of waste material produced in machining operations, practical investigations of force systems and the analysis of friction and simple machines.

Number work could be based on calculating the cost of the materials needed or the cost per item on a production line, the working out of the resultant of multiple forces, the principle of moments or the application of electrical circuit theory to solve simple circuit problems. Fractions and percentages of quantities, without the use of a calculator, could be used to find the amount of waste when producing items in a production line, the energy transmission or the composition of engineering materials such as low, medium and high carbon steels, aluminium alloys, magnesium alloys and tin or lead solder alloys.

Learners need to use conversion of metric units of measure when calculating the percentage waste on a production line, or when designing the layout of a production line. Another example could be working out the amount of materials needed to complete the production of an item.

Measures of central tendency using data sets, for example, could be comparing the output rates of one machine or comparing the output rates of different machines. Charts and diagrams could be drawn to analyse the down time of a piece of machinery. Learners could use data sets of the time between failure rates of similar pieces of machinery as well as the data sets of the life span of items under production. Data sets could be based on the length of the life of light bulbs which have been produced in the same batch on a production line.

They could explore probability through investigations of engineered products or services, for example, the analysis of the operation of a simple two-way lighting circuit, the selection of a simple component from a range of similar components, such as a drill, lamps and spanners as well as robotic selection of a coloured item from a range of colours.

Health and Social Care

Using number work could be demonstrated by calculating the cost of childcare, for each child in a day nursery for a specified number of sessions. This task could be extended by calculating the cost for a family of two pre-school children, one of whom is entitled to five free sessions in a day nursery. If the learners have elected to undertake a small health promotion campaign as outlined above, the cost of materials needed to undertake such a campaign could be calculated. Learners could use fractions and percentages to calculate the number of people, within a group, that are more likely to smoke, and how many cigarettes per day are smoked. Income and expenditure within a childcare setting could also be considered so that learners calculate VAT, as well as simple percentage increase and decrease. They could also calculate the increase in fees that are necessary to ensure a profit when hiring a room for a mother and toddler group. Work on the conversion of units could be included in tasks involving measures, for example, this could include designing a health promotion display where the measurements of the display board are given in different units, designing a healthy eating plan which involves quantities of foods given in different units, or calculating the distance travelled, where the distances are given in different units, to access a service provider such as a day nursery or a GP surgery.

Investigations could include an activity comparing the measures of physical health using measurements such as height and weight, BMI, peak flow measurements or resting and recovery pulse rates, by using graphs to display the data. This could be developed further by designing a fitness programme to improve fitness or a health promotion campaign to improve health, or by to considering the number of children in a day care setting for each half day session compared to staff numbers, or by considering the incidence of sexually transmitted disease or teenage pregnancy over the past 20 years. Learners could use data sets from classroom-based activities such as obtaining a range of heights, resting pulse rates, or BMI results, or from an activity such as calculating the mean age of children in a day nursery or calculating the modal age of residents in a residential care home. Learners should be able to draw and interpret line graphs, frequency tables and bar charts by using data sets from a Health and Social Care industry situation. For example, data sets giving the number of teenage pregnancies over the past 20 years, the average age of first time pregnancies, the ages of children in a day nursery, the number of smokers, by gender and age group, over the past 20 years.

Data sets can be obtained from **www.statistics.gov.uk** and can be used to draw and interpret charts, graphs and diagrams. Learners could use data sets obtained from primary research they have under taken for a health promotion campaign. Other examples could be from day nurseries or residential care homes, where learners need to work out the mean age of children or residents, or the length of stay of residents, or the age at which residents are first admitted to the home. Two similar service providers could be investigated to allow comparisons to be drawn. Learners need to be able to draw and interpret pie charts and two-way tables, using data from the Health and Social Care industry. These data sets could have been obtained from a health promotion campaign, for example, an analysis of questionnaires used, or data such as the gender balance at a local day nursery or school nursery, or at the local GP practice.

Learners could list meal choices in a nursery or day care centre, or list the combinations of strategies that could be used to promote good health. Again, this could be linked into a health promotion campaign. Learners could compare the probability of developing a life threatening disease as a consequence of lifestyle choices such as smoking or not smoking and the probability of developing lung cancer, binge drinking and the probability of cirrhosis of the liver, and so on.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the criteria in the assessment grid. This is for guidance only and it is recommended that centres either write their own assignments or adapt Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1, D1	Using numerical methods	A written activity, using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to complete the task to satisfy each of the criteria, by solving a given practical problem	A report containing written solutions to contextual real-life problems, showing clear evidence of using the numerical methods appropriately, and checking that the answers are reasonable and appropriate to the vocational problem being solved
P3, P4, M2, M3, D2	Using statistical techniques	A written activity, using relevant data appropriate to the learners' chosen vocational industry, requiring learners to complete the task to satisfy each of the criteria, by solving a given practical problem	A report containing written solutions to satisfy using discrete data to present, compare and interpret two data sets in order to solve a contextual real-life problem
P5, M4	Using probability	A written activity, using probability, in the context of the vocational industry, requiring learners to complete the task to satisfy each of the criteria	A report containing written solutions to satisfy using probability to work out outcomes for up to two independent events, in order to solve a contextual real-life problem

Essential resources

The nature of this course means that learners should have access to information from mathematics support materials as well as the vocational industry being covered. Information should include the internet, newspapers and relevant trade journals so that the learners can research aspects of the chosen vocational industry that enable them to gain an understanding of the concepts and principles involved. Learners will also need access to mathematical equipment including an electronic scientific calculator, a ruler, a pair of compasses and a protractor.

Indicative resource materials

For the vocational contexts of Travel and Tourism, Sport, Engineering and Health and Social Care

Travel and Tourism

Textbooks

Ian Roberts, Fiona Laing – *BTEC Introduction to Hospitality,Travel and Tourism,* (Heinemann, 2005)

Journals

Travel Weekly (www.travelweekly.co.uk)

Travel Trade Gazette

Websites

www.staruk.co.uk

www.ttglive.co.uk

Sport

Textbooks

Ray Barker, Bob Harris, Louise Sutton – *BTEC Introduction to Sport and Leisure* (Heinemann, 2005)

Engineering

Textbooks

Graham Lawler – *Understanding Maths: Basic Mathematics Explained 3rd Edition, Studymates*, (Aber Publishing, April 2006)

Jenny Olive – *Maths: a Student's Survival Guide (A Self-help Workbook for Science and Engineering Students*), (Cambridge University Press, Sept 2003)

Richard C. Spangler, John Boyce – *Mathematics for Technical and Vocational Students: A Worktext*, (Prentice Hall, 2nd Edition, March 2000)

Journals

A range of journals can be found at this site
http://www.sagepub.co.uk/journals.nav?level1=V00&currTree=Subjects&

Websites

The Institution of Engineering and Technology	http://www.theiet.org/
Flipside Extra	http://www.flipside.org.uk/

Health and Social care

Textbooks

Lynda Mason, Jo Irvine & Sarah Horne – *BTEC Introduction to Health and Social Care,* (Heinemann, 2004)

Journals

Community Care (www. communitycare.co.uk)

Nursery World

Nursing Times (www.nursingtimes.net)

Websites

Department of Health	www.dh.gov.uk
National Institute for Clinical Excellence	www.nice.org.uk
National Statistics	www.statistics.gov.uk

Unit 2: Applications of Geometry, Measures, Number and Algebra in Vocational Roles

Unit code: Y/601/9134

Level: 1

Credit value: 4

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to develop mathematical problem-solving skills in a range of different vocational roles. They will develop skills in using the properties of geometry, numeric and algebraic techniques, including ratios and the simplification of routine expressions, and measures.

Unit introduction

This unit provides learners with an introduction to the properties of geometry. Learners will be able identify shapes in different environments. Learners need to have an understanding of two dimensional (2-D) shapes, such as triangles and polygons, including their angle properties, and how shapes work and are used in real-life situations. Learners will develop skills in finding areas and volumes of simple 2-D and 3-D shapes.

Learners will also need to develop skills in producing scale drawings, using the properties of geometry and angles, which are needed to solve practical problems.

Algebraic techniques will also be developed throughout this unit. Learners will substitute values into simple formulae using two operations to solve problems in a routine context. In order to solve problems, learners need to be able to construct formulae with information given in words or as diagrams. Learners will also develop their problem-solving skills using ratios. The ability to use and understand ratio is useful in the workplace, particularly when applying the use of scales to solve a problem in context.

The ability to use and understand mathematical information is necessary in the everyday work of vocational occupations. Throughout this unit, learners can be introduced to the world of work by developing their problem-solving skills through practical applications in a vocational context. This will show learners the relevance of the skills and techniques included in this unit.

Learning outcomes

On completion of this unit a learner should:

1 be able to use the properties of 2-D shapes to solve routine problems in real-life context

2 be able to solve routine problems in real-life context using measures

3 be able to use numeric and algebraic techniques to solve routine problems in real-life context

Unit content

1 Be able to use the properties of 2-D shapes to solve routine problems in real-life context

2-D shape: triangles, (eg equilateral, isosceles, scalene, right-angle); quadrilaterals, (eg square, rectangle, trapezium, parallelogram, kite, rhombus); polygons, (eg pentagon, hexagon); angles, (eg acute, obtuse, reflex, interior, exterior, corresponding and alternate angles); properties of shape (eg number of sides, number of equal sides, number of parallel sides, size of angles, number of equal angles);symmetry (eg reflective and rotational); tessellations

2 Be able to solve routine problems in real-life context using measures

Measures: area, (eg triangles, rectangles, squares, compound shapes); cuboid, (eg surface area, volume); length; perimeter

3 Be able to use numeric and algebraic techniques to solve routine problems in real-life context

Algebraic techniques: expressions, collecting like terms, simplification, trial and improvement, operations, (eg expanding brackets and order of operations); formulae

Numeric techniques: ratios (eg simplest form, comparing quantities)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Solve real-life problems using properties of 2-D shapes	M1 Use the properties of shapes and angles in a real-life context to solve a problem	
P2 Solve a real-life problem by using reflective and rotational symmetry		
P3 Calculate the perimeter and the area of polygons to solve a real-life problem	M2 Solve a problem involving the perimeter and the area of compound 2-D shapes in a real-life context	D1 Solve a problem involving the surface area and the volume of cuboids within a real-life context
P4 Simplify expressions by collecting like terms to solve a routine problem in real-life context	M3 Solve two linear formulae arising from a real-life context	D2 Generate a formula and use algebraic techniques to solve a problem in a real-life context
P5 Expand one term over a single bracket to solve a routine problem in real-life context		
P6 Solve a routine problem in a real-life context by using ratio to compare quantities		

Essential guidance for tutors

Delivery

This unit should primarily be classroom based, with a mixture of classroom teaching and practical examples. The unit will require learners to become familiar and confident with necessary skills and to be able to apply them to solve problems in a vocational context. Learners should be encouraged to use their mathematical knowledge in order to solve a real-life problem in a vocational context.

Learners should be introduced to the content through a chosen vocational context. These themes can be used to deliver the mathematical content, with learners solving problems, using the appropriate mathematical methods. Visits from professionals, and practical visits to locations in the selected vocational industry should be encouraged. These may be useful for developing problems for learners to solve.

Learners can be introduced to the properties of geometry by looking at simple layouts of workplaces relevant to the vocational context that they are investigating. They will also need to use measures to work out the areas and the volumes of shapes. The use of symmetry could be introduced in the design processes of the chosen vocational workplace.

For most of their work, learners will also use routine algebraic expressions and formulae, sometimes without knowing that they are doing so. These could be constructed from information that they have been given, or from information that they have found from practical investigations of vocational contexts. Simple formulae are used to calculate the area and the volume of shapes; this will involve learners substituting numbers into formulae. The learner will need to be aware of 'BIDMAS' – the order of operations when more than one operation is required to find a solution. Learners can use trial and improvement as an additional technique to develop their substitution skills.

This unit enables learners to be more aware of, and more confident with, algebraic techniques. It also offers opportunities for the learner to develop an understanding of how to apply these algebraic techniques to solve real-life problems in vocational contexts.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Learners can be introduced to the properties of geometry by looking at the simple layouts of workplaces such as a travel agent's shop, a theme park or an airport. Consideration could be given to the layout of eating places in an airport, by looking at which shapes would fit best into the space. The idea of moving tables to seat large groups could be investigated, along with a consideration of which shape of table would make this easier. Working on the design of the layout of the entire airport, for example, will also involve learners in naming and identifying the shapes. The theme park is a good place to examine the properties of geometry, and, in particular, why triangles are used in the design of building.

Learners will need to use measures to work out the areas and the volumes of shapes. The area devoted to each seat on a plane could be looked at, for example whether a passenger has enough space on a plane for sitting or eating. The volume of luggage also needs to be calculated for the hold and overhead storage areas on a plane, and the volume of carry-on bags could also be calculated. An important aspect to consider at a theme park would be investigating safety flooring around rides that are suitable for younger children.

The use of symmetry could be introduced in the design process, for example, for an airport. The learner should be introduced to the properties of lines and angles. For example, in the investigation of the layouts of workplaces, the focus could be on the types of angle used and why they are used, as well as considering the need for the ease of movement around the workplace.

The learner will use ratio to understand how the required number of staff links to the expected number of customers, and how comparisons can be made between the numbers of passengers, for example, male, female and children. The ratio of men to women could also be a major factor in determining how many toilets would be required in a new building. In other areas of the travel and tourism industry, the use of formulae can also be considered. For example, the cost of package holidays, the cost of hotel rooms, the consideration of costs based on the number of people holidaying or the time of year. For some of this work, the learner can use formulae, for example, by using the appropriate formulae to calculate the area and the volume of shapes used in the real-life problem being investigated. This will also involve learners substituting numbers into formulae.

Sport

Learners should be introduced to the wide range of topics specified in the content through the vocational aspect of sport. Appropriate themes are the design of sports arenas and the locations where sport is played. Formulae relating to aspects of sport can also be considered.

Learners can be introduced to the properties of geometry by looking at the layout of a sports stadium and identifying the shapes within the layout. Learners can design a sports area, which includes a long-jump pit and a running track. In order to do this, learners will need to produce a plan, where drawing and measuring angles are needed. Learners could also consider the best location for an area for a shot put or javelin site when designing a sports arena. Parallel lines can be used to construct goal posts and running tracks.

Learners could measure the dimensions of swimming pools in local baths and the dimensions of an Olympic-size pool and work out how to calculate the enlargement of their local swimming pool to Olympic-size. This could be part of a task using ratios. This example could also be used for the area and the volumes of compound shapes. Properties of symmetry would also be related to design of venues.

Learners will use ratio to understand how the type of event will correspond to staffing levels, for example, the ratio of the number of tickets sold compared to the number of staff employed for that event. Learners could also look at the number of male and female competitors in a competition, or the number of balls used in a tennis tournament for a particular number of players.

Learners will be expected to work with routine formulae and these could be constructed from information on the maximum number of repetitions for toning. Learners would be expected to substitute values into sports related formulae, for example, body mass index. At distinction level, learners should use more challenging sports related formulae, for example, the Harvard Step test score,

$S = 100T \div 2H$, where S is the score, T is the test duration in seconds and H is total heartbeats in the recovery period.

Engineering

Learners can use the properties of geometry in a number of different tasks associated with engineering, most of which will probably come from the design stage of a project or component. For simple shapes, learners could look at the foundations of a building, which then could be developed into work with a 3-D shape, given the depth of the foundation. Then the learners could find the quantity of concrete required for the foundations of the buildings.

Learners will be required to work out the area of 2-D shapes to find out how much material they will need to manufacture a product. For example, by designing the net of a box, the learner could then find out the size of the sheet material they would need to produce the box. Learners would also need to calculate the volume of various containers to make sure that what they put into those containers will fit. They could also calculate the amount of material used to manufacture a product, and calculate the wastage produced to make that product. Learners could use the nets of shapes to work out the best way to make full use of the material available.

Learners could use a plan of a building or an orthographic projection of a component and use this to estimate and then to calculate the amount of materials required to complete a task. For example, learners could estimate and the calculate how much steel would be required in order to produce a particular product. Calculations for the pitch of a roof of a building or the cover for a belt drive could be used to introduce the properties of angles as well as the properties of perimeter to the learner.

There are many situations within engineering products or engineering services where formulae are used, and the learner needs to be able to construct a formula from a set of instructions or a set of requirements. For example, the total cost of producing a component is formed from; machining costs at £20 per hour, fitting costs at £50 and welding costs at £20 per hour. A formula can then be generated for the total cost of producing one component.

Learners could be given a simple formula for working out the length of a belt in a simple conveyer system and then be asked to substitute numbers into the formula in order to work out an answer. Information can also be given in a diagram of a system and then learners could be asked to construct a formula from the information given.

Ratio can be introduced to learners in several ways, in particular, by the use of scale models. Learners can then work out what the size of a finished item would be. Another way could be looking at the proportions of materials (wood, metal and plastic) in a particular product. Learners could then be given the ratios of the materials so that they can work out how much of each material is used. Simple machines which involve force ratios and movement ratios, could be used for practical investigations.

Health and Social Care

Learners can be introduced to the properties of geometry by looking at the simple layout of a classroom, an outdoor play area in a day nursery, a bedroom in a residential care home, a display board for a health promotion activity, or the display of the work children have completed in a childcare setting. Learners can be introduced to the concept of shape by considering the different shapes of work desks, and by considering which would fit in the space available, giving the optimum room for a range of different activities. Different play areas can be designed allowing for wet play, messy play, quiet play and so on. A display board could be designed using posters of different shapes, or leaflets for either a Health Promotion programme or an Education for Young Children theme.

By using measures, learners can design a floor area in a childcare facility. This could also include the consideration of an outdoor play area, which has safety flooring around the play equipment, a range of games such as hopscotch, a small running tracks or perhaps roadways for toy cars. These examples show that the use of lines and distances need to be considered in the designs. Perimeters of play areas could be calculated, and the volume and shape of soft play equipment could also be calculated and linked to the area available. A health promotion theme could also be used, with learners designing a range of materials in different shapes and sizes in order to get their message across.

The use of symmetry could be introduced in the design process, of a nursery setting or the design of an information display board. The learner should be introduced to the properties of lines and angles by investigating a suitable layout of equipment to ensure that the area is safe for young children. The design of a health promotion display could involve layout for maximum impact.

Learners could be given a simple formula for working out the play areas required for a given number of children at a nursery and be asked to substitute numbers into that formula to work out an answer. Learners could also be given a diagram of a play ground and then be asked to construct a formula from the information given.

The learner will use ratio to work out how the number of staff required is directly linked to the number of children who can be accommodated within a childcare setting. Learners could also consider the different ratios required for different age groups. The ratio of babies to toddlers to pre-school infants could also be considered in terms of the facilities which need to be available, for example, cots for babies. Ratio could also be considered in terms of body proportions within normal growth patterns through various stages of life.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole class teaching: • introduction to unit content, scheme of work and assessment strategy • tutor-led revision of the properties of shape • draw, explain and explore properties of shape; number of sides, number of equal sides, number of parallel sides, size of angles, number of equal angles, lines of symmetry and order of rotation • extend properties of shape to include the use of cross-sections, or nets, to compare different solids • explain perimeter, area and volume of shapes • explain perimeter, area and volume of compound shapes Individual learner activity: • tasks and activities using perimeter, area and volume of shapes to solve problems • tasks and activities using properties of shape; number of sides, number of equal sides, number of parallel sides, size of angles, number of equal angles, lines of symmetry and order of rotation
Prepare for and carry out assignment 1 (P1, P2, P3, M1, M2, D1)

Topic and suggested assignments/activities and/assessment
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • explain mean, median, mode and range using discrete data • explain how to compare mean, median, mode and range of two data sets • tutor demonstration of representing discrete data by using frequency tables, bar charts, line graphs, pie charts and two-way tables • tutor demonstration of how to compare and interpret frequency tables, bar charts, line graphs, pie charts and two-way tables for two data sets Individual learner activity: • tasks and activities finding, and comparing, mean, median, mode and range using discrete data • tasks and activities representing discrete data • tasks and activities representing, comparing and interpreting two data sets, using discrete data
Whole class teaching: • tutor-led revision of the rules of algebra, including the order of operations • explain simplification of algebraic expressions by collecting like terms • explain expanding a single term over a single bracket • explain how to construct formulae, in words, from given information • extend this to include constructing formulae, in a vocational context, using algebra • extend this to include substituting values into formulae which involve at least two operations • explain how to solve straightforward linear equations; including linear equations which involve at least two operations Individual learner activity: • tasks and activities simplifying algebraic expressions • tasks and activities expanding brackets • tasks and activities constructing equations and formulae • tasks and activities solving linear equations and using formulae • explain how to use ratios to compare two quantities • explain how to express ratios in the simplest terms Individual learner activity: tasks and activities using ratios to solve routine problems
Prepare for and carry out assignment 2 (P4, P5, P6, M3, D2)

Assessment

Assessment should be presented in the form of a portfolio where learners have demonstrated their skills and understanding clearly. Learners should choose the skills most appropriate to solving the problems with which they are presented. The vocational nature of this course means that early consideration should be given to the activities and tasks learners are to complete. These should be based on appropriate industry situations and allow learners to progress from pass to distinction level by varying the skills used.

For P1, learners need to identify 2-D shapes and their properties, for example, the number of sides, the number of equal sides, the number of parallel sides, the sizes of angles and the number of equal angles. Learners should be able to identify two shapes and their properties in each of two situations. For P2, learners should identify lines of symmetry and also reflective and rotational symmetry. Learners should be able to identify one triangle, one quadrilateral and one polygon across P1 and P2, as well as their properties, in the situation being investigated.

Learners need to use formulae to calculate areas of specific 2-D shapes. For P3, learners should recognise that perimeter is the distance around a shape, and should also be able to find area. Learners must use correct units appropriately in their working, and they should demonstrate a clear understanding of the methods they use. Learners should find the area and perimeter of two different shapes, one of which should be a triangle.

For P4, learners must be able to simplify two simple expressions by collecting like terms and expressions can contain more than one variable, but must be to the appropriate level, and show a use of algebra that is representative of the vocational industry being investigated. They should simplify two expressions by collecting like terms.

For P5, learners must be able to expand a single bracket by a single term in two cases. These expressions can contain more than one variable, but must be to the appropriate level, and should show a use of algebra representative of the vocational industry being investigated. They should simplify two expressions by multiplying a bracket by a single term.

For P6, learners need to use ratios to compare quantities, and to interpret, in straightforward terms, what these comparisons mean. Learners can explain that 6:12 given as a ratio of men to women, means that there are twice as many women as men. For three situations, they should compare two quantities, find the ratio of those two quantities, and express the ratio in its simplest form.

M1 requires learners to use the properties of shapes, to begin to tessellate them and to show the best use of a given space. This requires knowledge of the properties of the shapes and their angles. Learners could demonstrate this by using real vocational industry problems. Learners should consider one situation in which they discuss two alternative arrangements of shapes, and explain, using the properties of shape, why one is preferable. All parallel or equal sides and equal or right angles should be marked on diagrams.

M2 is an extension of P3, and requires learners to extend their understanding of area by recognising that compound shapes are made up of two or more of the 2-D shapes that they have already worked with. Learners will be expected to calculate the area of the compound shape by breaking it down into individual shapes. Learners will be expected to find the area and the perimeter of two different compound shapes.

For M3, learners are expected to solve simple linear formulae with unknowns on one side. Learners are also expected to solve two linear formulae which involve at least two operations, for example, $15p = 2l + 30$. This will also involve learners substituting numbers into formulae.

For D1, learners need to use volume and surface area to solve a real-life problem. Learners should find the surface area and volume of two different cuboids, in order to solve a real-life problem.

For D2, learners need to show that they can construct a formula. For example, they need to derive a formula in a vocational context, and then they should use their formula to solve a real-life problem. Learners need be able to interpret information to derive a formula in words, and then be able to write the formula using algebra. Learners also need to demonstrate that the formula is correct for at least two given values by using algebraic techniques and learners should not do this by using trial and improvement methods. They should then use their formula to predict at least three unknown values. This will also involve learners substituting numbers into formulae.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Learners could identify shapes within a travel and tourism context, for example, by looking at the floor plans of a hotel lobby with a hexagonal reception desk, a rectangular concierge station and a triangular luggage storage area.

Examples of travel and tourism contexts that could be used, include measuring the area of hotel rooms so that furniture of appropriate dimensions can be purchased or designing a 'Welcome Board', for information leaflets, in a holiday resort. This task could be extended by working out the area and the perimeter of compound shapes. Learners could use properties of shape by using real travel and tourism industry problems, for example, calculating the best configuration of luggage in a conference hotel storage area which takes up the least amount of space. Learners need to use area, volume and surface area to solve a problem. An example of this could be choosing between two suitcases which comply with the size guidelines. Learners could then be expected to decide which suitcase would be better in terms of size, ease of carrying and so on.

By using algebraic techniques, learners can show that three groups of one travel representative and five passengers can be written as $3(R + 5P) = 3R + 15P$. An example of a formula could be $2A + 170 = 590$, which represents two adult tickets plus a flight supplement of £170, is equal to the total cost of £590. Learners could then be asked to calculate the cost of an adult ticket. To show that they can construct a formula to solve a problem, learners could derive a formula to show holiday costs if flights for adults cost £x each and each flight has a baggage charge of £y per person travelling. The next stage of the question could be to work out how much each flight would cost if the total cost is £600 and the baggage charge is £30 for each person. Learners would be expected to produce the formula $3x + 3y = C$ (for 3 adults travelling), or equivalent, and be able to use it to find x, given $y = 30$ and $C = 600$.

Learners should be able to explain that 6:12 given as a ratio of men to women means that there are twice as many women as men.

Sport

Learners could identify shapes within a sporting context, for example, be able to identify a triangular step area or rectangular weight area.

Area and perimeter can be investigated, for example, by working out how many squash courts can fit into the floor plan of a leisure centre or how many tiles are needed around the edge of a swimming pool. Examples of area and perimeter can be extended further by using compound shapes. For properties of shape, an example of working out how a changing room can be organised to fit in the maximum number of lockers can be used. Learners need to use area, volume or surface area of shapes to solve to a problem. An example of this could be to compare the area of a football pitch to a rugby pitch and decide which one is the larger, and then find the volume of topsoil needed for the pitch.

Learners should be able to use algebraic techniques to simplify expressions that represent the real-life contexts investigated. For example, if there are three groups containing one fitness trainer and five customers, this can be written as $3(T + 5C) = 3T + 15C$. Learners could, for example, use $D = 6l + 50$ to find the lap length of a circuit, if six laps of a circuit plus 50m warm up are to be completed. Learners would have to show that, from simple instructions, they can construct a formula to solve a problem. An example could be, constructing a formula to show the total cost to attend an event for x number of adults and y number of children. If learners were then given the number of adults attending and the total cost, they could calculate the number of children attending. Learners would be expected to derive, and then use, the formula of $9a + 4c = C$, with £9 per adult and £4 per child.

Learners should be able to explain that 6:12 given as a ratio of men to women, means that there are twice as many women as men.

Engineering

Learners need to identify 2-D shapes and their properties. They could investigate these shapes by, for example, designing tiles or children's toys. This could by considering the packaging of the product or by considering the most efficient use of laminate sheets to produce a particular product.

Learners could use their understanding of area, for instance, when planning the best use of materials for a particular product or the packaging of the product. Examples of area and perimeter can be extended further by using compound shapes. Learners could compare different shaped fuel tanks including rectangular cross sections, using volume, or nets. Another example could be working out the optimum use of sheet material when cutting gaskets (sometimes referred to as packings). These may be of different shapes and have different combinations of rectangular, triangular and trapezoidal sections. Learners would need to be able to use area, volume and surface area to solve a problem, for example, by comparing the area, surface area and the volume of various shapes, learners could find which shape gives the better use of the space available when designing new packaging for a particular product.

Being able to use algebraic techniques to simplify expressions could be done through working out the areas of 2-D shapes. For example, a rectangle, which has area = $l \times b$ and perimeter = $2l + 2b$, could be used to determine the amount of laminate needed to manufacture simple products such as covers. Learners are expected to use formulae to find values of unknowns, for example, $T = s + 6c$ could represent the total cost of producing 6 items with a set up price plus the cost per item. Learners also need to show that when they are given simple instructions, they can construct a formula to solve a problem. For example, learners could construct a formula that determines the (planned) time for drilling and turning, when they are given the cutting speeds and feeds for a particular machine.

Learners are required to use ratio to compare quantities. This could be through the interpretation of scaled drawings and models, areas and volumes, or through calculating the final pressure in a cylinder of an engine, that has a given compression ratio.

Health and Social Care

Learners should identify shapes within a Health and Social Care context, for example, the floor plan of a day nursery classroom with hexagonal children's work desks, a rectangular teacher's desk and a circular floor mat for story time. Consideration of items in a soft play area or outdoor play equipment could be used here. Examples of area and perimeter can be extended further by using compound shapes. Learners should consider the properties of shape by using real Health and Social Care industry problems such as calculating the best configuration of different shaped soft play equipment which takes up the least amount of space in a storage area in a children's day nursery.

Learners are expected to use formula to find values of unknowns, for example, they could calculate the full cost of one child attending five full days of childcare.

Learners also need to use area, volume and surface area to solve a problem. This could be the choice between two storage cupboards, for example, a tall cupboard with narrow shelving or a smaller cupboard with wider shelving which could be used in the day nursery for storing creative activity equipment and paper of different sizes. The learners would be expected to decide which storage cupboard would be better in terms of size and ease of storage.

Examples of Health and Social Care contexts that could be used include measuring the area of a room, within a nursery, so that furniture of appropriate dimensions can be purchased or designing a health promotion board for display in a school or health centre with leaflets and posters relating to a particular topic.

Learners need to be able to use algebraic techniques to simplify expressions that represent the real-life contexts that are being investigated. For example, if there are three classes of two teachers and ten children, then this can be can be represented as $3(2T + 10C) = 6T + 30C$.

Learners need to be able to construct a formula to solve a problem, for example, they could derive a formula to show the cost per day of one week's attendance at a childcare facility if the attendance cost per day is £x and the cost of lunch per day is £y. The next stage of the question would be to suggest that if the total cost is £950 and the charge for lunch per day is £15, how much would the attendance cost? In order to solve the problem, learners could be expected to produce the formula, $5x + 5y = \mathrm{C}$ and be able to use it to find a value for x, given that the total cost is £950.

Learners should be able to explain that 2:8 can be expressed as a ratio of staff to children, and that this ratio can be simplified further to 1:4, means there are four times as many children as staff.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the criteria in the assessment grid. This is for guidance only and it is recommended that centres either write their own assignments or adapt Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, M2, D1	Using properties of shape	A written activity, using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to use the properties of shape, perimeters, areas and volumes of shapes to solve a practical problem in a vocational context	A report containing written solutions to problems to satisfy the properties of shape, and perimeter, area and volume appropriate to the contextual real-life problem, within the vocational industry
P4, P5, P6, M3, D2	Using algebra and ratio	A written activity using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to use algebraic skills and ratios to solve a real-life problem in a vocational context	A report containing written solutions to the use of algebra and ratio to solve a contextual real-life problem within a vocational industry

Essential resources

The nature of this course means that learners should have access to information from mathematics support materials as well as the vocational industry being covered. Information should include the internet, newspapers and relevant trade journals so that the learners can research aspects of the chosen vocational industry that enable them to gain an understanding of the concepts and principles involved. Learners will also need access to mathematical equipment including an electronic scientific calculator, a ruler, a pair of compasses and a protractor.

Indicative resource materials

For the vocational contexts of Travel and Tourism, Sport, Engineering and Health and Social Care

Travel and Tourism

Textbooks

Ian Roberts, Fiona Laing – *BTEC Introduction to Hospitality,Travel and Tourism,* (Heinemann, 2005)

Journals

Travel Weekly (www.travelweekly.co.uk)

Travel Trade Gazette

Websites

www.staruk.co.uk

www.ttglive.co.uk

Sport

Textbooks

Ray Barker, Bob Harris, Louise Sutton – *BTEC Introduction to Sport and Leisure* (Heinemann, 2005)

Engineering

Textbooks

Graham Lawler – *Understanding Maths: Basic Mathematics Explained 3rd Edition, Studymates,* (Aber Publishing, April 2006)

Jenny Olive – *Maths: a Student's Survival Guide (A Self-help Workbook for Science and Engineering Students*), (Cambridge University Press, Sept 2003)

Richard C. Spangler, John Boyce – *Mathematics for Technical and Vocational Students: A Worktext*, (Prentice Hall, 2nd Edition, March 2000)

Journals

A range of journals can be found at this site
http://www.sagepub.co.uk/journals.nav?level1=V00&currTree=Subjects&

Websites

The Institution of Engineering and Technology	http://www.theiet.org/
Flipside Extra	http://www.flipside.org.uk/

Health and Social care

Textbooks

Lynda Mason, Jo Irvine & Sarah Horne – *BTEC Introduction to Health and Social Care,* (Heinemann, 2004)

Journals

Community Care	www. communitycare.co.uk
Nursery World	
Nursing Times	www.nursingtimes.net

Websites

Department of Health	www.dh.gov.uk
National Institute for Clinical Excellence	www.nice.org.uk
National Statistics	www.statistics.gov.uk

Level 2 Units

Unit 1: Applications of Number, Statistics and Probability in Vocational Roles

Unit code: A/601/9207

Level: 2

Credit value: 5

Guided learning hours: 50

Unit aim

The aim of this unit is to enable learners to solve mathematical problems in a range of different vocational roles. They will develop skills in using number, including fractions, decimals, percentages and standard form, in statistical calculations, diagrams and sampling techniques by using discrete and continuous data and use probability to predict outcomes.

Unit introduction

This unit provides learners with the opportunity to develop their number skills including the use of fractions, percentages and decimals and using standard form. Learners should be able to convert units between metric and imperial units, and to approximate or round a number to a given number of decimal places or significant figures.

This will enable learners to perform complex calculations by using the four operations of addition, subtraction, multiplication and division to solve problems relating to length, area, volume, time, money, weight and mass in practical situations.

Learners will not only learn how to use statistical techniques, but could also be given the opportunity to plan for and carry out the collection of data for an investigation, as well as represent, analyse and interpret the data sets that they collect.

Learners will extend their understanding of simple probability in order to predict the outcomes of activities which involve exclusivity, independence and frequency in order to estimate the probability of an event occurring.

The unit will also present the opportunity to develop learners' use of graphical representation to compare the relationship between variables. Learners will use techniques such as frequency diagrams, pie charts, scatter diagrams, box plots, cumulative frequency tables and diagrams and histograms to enable them to analyse and interpret data. Learning to develop mathematical skills through a practical application in a vocational context will show learners the importance of these skills to future employment prospects and to organisations within the world of work.

Learning outcomes

On completion of this unit a learner should:

1 be able to use number to solve problems in real life contexts

2 be able to use probability to compare predicted outcomes in real-life situations

3 be able to use statistical techniques in real-life situations

Unit content

1 Be able to use number to solve problems in real life contexts

Representation of number: equivalence of fractions, decimals, percentages; conversion between fractions, decimals, percentages: rounding numbers; common metric and imperial conversions (eg kilograms, pounds, gallons, litres, kilometres, miles)

Solving problems: the four operations (fractions; decimals; negative numbers); understand the effect of multiplying or dividing by numbers between 0 and 1; percentage errors

Powers and roots: standard form

2 Be able to use probability to compare predicted outcomes in real-life situations

Probability: probability scale; mutually exclusive events; independence; the AND and OR rules for probability; tree diagrams; relative frequency; comparing outcomes of experiments.

3 Be able to use statistical techniques in real-life situations

Representation of data: eg frequency diagrams, pie charts, scatter diagrams, box plots, cumulative frequency tables and diagrams, histograms

Data analysis: modal class; grouped data (eg mean, median and interquartile range); comparison of distributions (eg discrete and continuous data, measures of central tendency, range, shape of graphs); sampling (eg sample size, sampling techniques (eg simple, systematic, stratified))

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Use fractions, decimals and percentages to solve real-life problems in context	M1 Convert between metric and imperial measurements and use rounding to give answers to real-life problems	D1 Use percentage error to a sensible degree of accuracy in real-life problems
P2 Convert numbers to and from standard form to solve real-life problems in context	M2 Calculate using standard form to solve real-life problems in context	
P3 Use the probability scale from 0 to 1 to represent outcomes in work-related real-life situations	M3 Use the AND and OR rules for probability to predict outcomes in practical situations	D2 Compare two situations using probability and give advantages of one situation
P4 Use statistical sampling in real-life situations to compare discrete and continuous data	M4 Make predictions using trends found in data in contextual situations	D3 Contrast two situations, referring to statistical techniques, making justified suggestion for improvement in at least one
P5 Represent data by using two of the following statistical diagrams; scatter diagrams, cumulative frequency diagrams, box plots and histograms in real-life situations	M5 Interpret the statistical diagrams in P5	

Essential guidance for tutors

Delivery

This unit should primarily be classroom based, with a mixture of classroom teaching and practical examples. It should cover the mathematical content through practical examples of situations that arise in the vocational industry, and will require learners to explore areas of vocational contexts and to solve problems by using the mathematical skills they have been taught. Learners should be encouraged to use their knowledge of mathematical applications in a holistic manner in order to solve a real-life problem in a vocational context.

Learners should be introduced to the relationships between fractions, decimals and percentages; learn to convert between the different forms, and to apply this learning in situations arising from practical problems. Learners will be expected to demonstrate that they can use fractions, decimals and percentages with confidence, and that they understand how to work with the more difficult numbers found in real-life situations. The more challenging aspects of this section require learners to be able to reverse percentages, for example, to be able to find original costs of the practical contexts they are investigating. Multiples, factors and metric and imperial conversions can be introduced and explored through practical problems relating to their chosen vocational contexts. It is expected that learners will use the four operations with decimals and fractions in context and be able to demonstrate their use when completing the assignments or tasks.

Using standard form is important in real-life contexts, and should be introduced by using powers and index form. This can be illustrated by including very large and very small numbers, and the topic can be approached as an extension of the work on multiples, with conversions between different metric units being used as a starting point.

Learners will be expected to have a basic understanding of probability such as likelihood and relative frequency. Learners should be able to understand that some events are independent or mutually exclusive, and should be able to calculate the probabilities for two or more events. Learners could use sample space diagrams and tree diagrams to represent the events and calculate the probabilities. This topic can be approached through practical work based on vocational contexts.

Learners should also be introduced to the use of data in a wide range of situations relating to vocational contexts. It is expected that learners will be using continuous data that can be grouped in a sensible manner to enable the development of the higher skills of cumulative frequency and histograms. Moving averages is not part of the required content, but the topic can be introduced to learners, if appropriate.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Learners could be introduced to the relationships between fractions, decimals and percentages, learn to convert between the different forms, and apply this learning in situations arising from a tour-operator business. Examples could include, the use of percentages in calculating commissions, the use of fractions in brochure design, by looking at ratios of pictures to text, pricing structures, load factors and so on. The more challenging aspects of this section require learners to be able to find reverse percentages. For example, show the total saving by finding the original cost of a £895 holiday, before a 20 per cent discount is applied.

Multiples and factors can be introduced and explored through transport planning, including, the seating arrangements on planes and trains, coach transfer arrangements and room allocations. Other examples could include, the different table combinations to seat 200 guests or the seat configurations on a flight for 200 or more passengers.

Metric and imperial conversions can be explored through route planning in both miles and kilometres and the costs for a transfer or coach holiday that includes crossing the channel, with the initial costs being given in both kilometres and miles. It is expected that learners will use the four operations with decimals and fractions in context when completing the assignments. Conference organisation can also give rise to situations involving costs, seating arrangements an so on. Negative numbers can be approached through practical contexts such as the number of delegates signing up for, or withdrawing from, a conference.

Distances travelled can be used as a source to convert to and from standard form in various units, for example from the UK to Australia. Currency conversions can give rise to very small numbers when converting to and from 1 GBP. For example, the US dollar (USD) and the euro (EUR) are the two currencies most commonly converted from sterling (GBP). For more extreme examples, where appropriate, less familiar currencies can be used. These can also be used to cover the work on multiplying and dividing by numbers between 0 and 1.

Probability can be approached through practical work, based on the investigation of a theme park topic where games of chance are available. Learners can experience the difference between theoretical and experimental probability by designing and testing a game. Further examples can be found by investigating airline and train punctuality, and seasonal visitor figures to a particular tourist attraction.

Learners should be introduced to the use of data in a wide range of situations relating to the travel and tourism industry. These can include an analysis of brochure design, a questionnaire on product choices, customer profiles for a proposed coach tour or theme park. It is expected that learners would be using continuous data, that can be grouped in a sensible manner, to enable access to the higher skills of cumulative frequency and histograms. Opportunities should be available for learners to compare, for example, two theme parks with different customer profiles, looking at criteria such as different types of ride, queue lengths and distance between rides.

Sport

Learners should be introduced to the relationships between fractions, decimals and percentages; learn to convert between the different forms, and apply this in situations arising from nutritional analysis. Percentages can be used to compare similar foodstuffs or fractions could be used to show the break down of a food or a meal into protein, carbohydrate and fat.

To achieve the higher levels, learners should be able to find reverse percentages, for example, by finding the original fat content of crisps before a 20 per cent reduction in fat to show the total amount of fat saved.

Multiples and factors can be introduced and explored through combining weights, seating arrangements on planes and trains, coach transfer arrangements and room allocations for tournaments, different bus or mini bus arrangements that would take 200 competitors to a variety of events.

Different weights can be used to explore ratios and fractions, for example 0.5kg, 1kg, 2kg, 2.5kg and 5kg can be combined in different ways in a weight-training programme. Metric and imperial conversions can be explored by comparing the measurements of modern sports equipment with the measurements of the equivalent sports equipment from previous eras. Examples of this could be the weight of a football, the dimensions of sports fields or pitches or by route-planning in miles and kilometres and also working out costs for a journey to a tournament, by giving the costs for both metric and imperial measures.

Scale could be used in plans of sports arenas or pitches, in travel or planning, for example, in a marathon race. It is expected that learners will be able to use the four operations for decimals and fractions when completing the assignments. These calculations can arise from nutritional analysis, increase in fitness, bulk buying of kits to include discount, and currency conversion and so on. Learners can carry out fitness tests at the beginning and at the end of a fitness training programme, and then analyse the changes in fitness.

Distances travelled can be used as a measurement to convert to and from standard form in various units, for example, the distances travelled, from the UK to Australia, by touring sports teams. The cost of the development of sporting arenas, the comparisons between arenas built in different countries or during different eras could also be investigated. These can also be used to cover the work on multiplying and dividing by numbers between 0 and 1.

Probability can be best approached through practical work, based around an international event such as the Olympics, where medal positions could be predicted based on past performance. Learners can experience the difference between theoretical and experimental probability using a practise basketball game, and counting successful shots and then by comparing this with the successful shots from the performance of a professional. Two event probabilities can be explored using, for example, heptathlon events. This involves finding the probability of winning the second event after winning or losing the first event.

Learners could be introduced to the use of data by nutritional analysis; where a questionnaire on product choices and customer profiles for a proposed sports centre can be investigated. It is expected that learners will use continuous data such as VO2 data (oxygen consumed while exercising at a maximum capacity), height and mass that can be grouped in a sensible manner to enable access to the higher skills of cumulative frequency and histograms. Opportunities should be available for learners to compare, for example, a range of outcomes in the Olympic Games over a period of time, or the male/female VO2 maximisation.

Engineering

Learners will be expected to demonstrate that they can use fractions, decimals and percentages with confidence and that they understand how to work with the more difficult numbers that are found in real-life situations. Fractions can be introduced through formulae involved in electrical circuits or composition of alloys. To achieve higher levels, learners should be able to find reverse percentages, for example, show the total amount of money saved by finding the original cost of a £895 component before a 20 per cent discount.

Multiples and factors can be introduced and explored through production planning, for example, the different rates of work needed to make 2000 components.

Metric and imperial conversions can be explored by using litres and gallons to compare car performance over the years, now given in km per litre instead of mpg. Production planning and quality assurance can also give rise to situations involving these areas through costs, seating arrangements, factory layout, production times and so on. Negative numbers can be approached through practical contexts such as deceleration, removal of mass, flow-rate from a tank, heat flow, overall tension in a hoist, or the effect of raising masses.

Quantities produced and various dimensions can be used as a source to convert to and from standard form in various units. The use of very small numbers could come from working with weights of atoms in the chemical industry or working with very small time periods, for example, when developing circuit boards for computers, washing machines and so on. These can also be used to cover the work on multiplying and dividing by numbers between 0 and 1.

Probability can be approached through practical work based around life expectancy of components and particle filtering. Learners can experience the difference between theoretical and experimental probability by designing and testing filters or components. Further examples can be found by investigating failure rates of successive pieces of equipment or the effect of outside factors on efficiency.

Learners should be introduced to the use of data by using an analysis of production figures, a questionnaire on product choices or customer profiles for a proposed new product. Opportunities should be available for learners to compare, for example, the different types of power station, the rate of usage of different lubricants or 'green' energy sources.

Health and Social Care

Learners will be expected to demonstrate that they can use fractions, decimals and percentages with confidence and that they understand how to work with the more difficult numbers found in real-life situations. The more challenging aspects of this section require learners to be able to find reverse percentages, for example, show the total saving by finding the original cost of a day-care place costing £75 per day before a 15 per cent reduction.

Multiples and factors can be introduced and explored through the number of children attending a day nursery or the allocations in a residential care home, for example, the number of children attending a nursery each day on a full-time or for a session each day. Metric and imperial conversions can be explored through considering weight and height conversions or room dimensions within a child care setting.

Using standard form to represent incidence of disease, population trends and the study of other demographic data would enable learners to understand both very large numbers and very small numbers in a Health and Social Care context.

Probability can be approached through practical work based on inheritance of dominant, recessive or sexually-related disease or the incidence of disease based on lifestyle choices, environment or geographical location. Learners can experience the difference between theoretical and experimental probability by considering, for example, children's growth and in predicting their probable adult height using mid parental growth calculations.

Learners should be introduced to the use of data and this could include examples such as a questionnaire on GP surgery opening times, the analysis of a range of health promotion literature, the services over and above the core service provided by an organisation within the health and social care industry, the waiting times for specific procedures within the local NHS Trust, or by considering the incidence of disease, locally, nationally and internationally. Opportunities should be available for learners to compare, for example, the range of services provided by one GP surgery compared to that of another within the same location or a nearby location.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • introduction to unit content, scheme of work and assessment strategy • tutor-led revision of fractions, decimals and percentages to solve routine number problems • tutor-led revision of the use of an electronic scientific calculator • extend concepts of fractions, decimals and percentages to include non-routine number problems • explain and apply percentage error to a sensible degree of accuracy • explain and apply conversion between metric and imperial measures • explain and apply index notation and standard form Individual learner activity: • exercises in using fractions, decimals and percentages, without the use of an electronic scientific calculator, including the use of percentage error • activities and tasks using and converting between metric and imperial measures • activities and tasks converting numbers to and from index notation • activities and tasks converting numbers to and from standard form
Prepare for and carry out assignment 1 (P1, P2, M1, M2, D1)

Topic and suggested assignments/activities and/assessment
Whole class teaching: *It is expected that learners will add, subtract, multiply and divide whole numbers and decimals throughout this unit.* • tutor-led revision of probability in terms of events, outcomes and likelihood, and how probability can be used to compare two events • explain how to use probability scales • explain the rules AND and OR to predict outcomes • tutor to demonstrate comparing two events using probability Individual learner activity: • activities and tasks using probability
Prepare for and carry out assignment 1 (P3, M3, D2)
Whole class teaching: *It is expected that learners will either be given data sets that are appropriate to their chosen vocational context or that learners will collect their own data sets.* • tutor-led revision of mean, median, mode and range, using discrete data, and how to compare mean, median, mode and range of two data sets • extend previous bullet point to include continuous data, mean from a table • extend to include using mean, median, mode and interquartile range with continuous data • explain using statistical diagrams to represent data in practical situations • explain using statistical sampling to compare at least two data sets Individual learner activity: • activities and tasks using mean, median, mode and interquartile range with discrete and continuous data activities and tasks representing, comparing and interpreting data sets using sampling methods
Prepare for and carry out assignment 1 (P4, P5, M4, M5, D3)

Assessment

Assessment should be through tasks that allow the learner to demonstrate that they meet the criteria in one or more areas. Assignments should focus on topics within the learner's chosen vocational industry, as these will give rise to data most suited to the higher level skills. Each assignment should be broken down into tasks to enable learners to demonstrate a range of numerical and statistical skills. Learners will not be expected to deal with each content strand separately, but should be assessed through projects that include working with each area in a series of tasks.

In order to achieve P1, learners must show that they can use calculations involving fractions, decimals and percentages to solve problems set in a vocational context. They should show that they can perform the four operations with fractions and decimals and convert to and from each form of fraction, decimal and percentage, each at least once in the situation.

To achieve P2, learners must demonstrate that they can use standard form when dealing with very large or very small numbers. Very large numbers should be of the order of 10^4 or greater, very small numbers in the order of 10^{-3} or smaller. Learners should be able to convert to and from standard form for at least three very large and three very small numbers.

For P3, learners should demonstrate an understanding of the probability definitions and include examples of calculations to find probabilities, for three instances.

To achieve P4, learners could produce an analysis of data resulting from research, for example questionnaires, surveys, experiments or secondary data sets. Learners should demonstrate at least one sampling technique.

For P5, learners must be able to represent the data using at least two from a choice of scatter diagrams, cumulative frequency diagrams, box plots and histograms. For M5, learners must interpret the data and summarise their findings in straightforward terms.

To achieve M1, learners should convert to and from metric and imperial measures (for example, length, distance, volume and mass) in three problems. They should use their units in a calculation which requires two operations for each problem. Weight and height measures could be used.

To achieve M2, learners must demonstrate that they can calculate with standard form when dealing with very large or very small numbers. Very large numbers should be of the order of 10^4 or greater, very small numbers in the order of 10^{-3} or smaller. Learners should give at least one example to show they can add, subtract, multiply and divide in each of two situations, one with very large numbers, and the other with very small numbers, giving their answers in standard form.

For M3 learners should be able to find probabilities combining two or more events for three situations. These should demonstrate the use of the OR and the AND rules. Tree diagrams and sample spaces may be used to calculate probabilities. These calculations might involve using decimals, percentages or fractions that can also be assessed towards P1.

To achieve M4, learners should make predictions based on data trends. These could be shown by either using moving averages, or graphically. Predictions must be clear and to the required level of difficulty and not just simple observations. Learners should make predictions on each data set and investigate trends for two data sets, using graphs or moving averages, if appropriate, for each data set.

For M5, learners should include the language of probability in their analysis with examples showing they understand how probability theory can be used to make predictions. Learners should compare two sets of data, and for each set of data use a justified sampling technique, use probability to illustrate or support their recommendations, and use at least two of mean, or estimate of the mean for grouped data, median, modal class, range and interquartile range.

For D1, learners should round answers obtained on a calculator to a reasonable number of decimal places or significant figures (for example two decimal places or three significant figures) and explain their reasons for this. They will be expected to demonstrate this in at least three situations. After rounding appropriately, learners should calculate the percentage error between the rounded and unrounded answers.

For D2, learners should be able to compare fully two or more situations. They should be able to demonstrate understanding of combined probabilities for each situation. They should be able to give a justified decision for the advantages of one situation over the other, and they should include the language of probability in their analysis, using examples to show that they understand how probability theory can be used to make predictions.

For D3, learners should contrast two situations using statistical techniques and for each situation demonstrate their confidence with number, as assessed in P1, P4, and M1. Learners should compare two data-sets, and for each set of data, use a justified sampling technique and use at least two of mean, or estimate of the mean of grouped data, median, modal class, range and interquartile range.

For each data-set they should represent their data using at least one from a choice of frequency diagrams, pie charts and scatter diagrams and one from a choice of box plots, cumulative frequency tables and cumulative frequency diagrams or histograms.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Learners could demonstrate their number skills by calculating the discounts given by tour operators, dependent on the number of customers or the season. Learners could use percentages to calculate commissions; fractions or ratio to explore different salary structures; fractions or percentages to analyse the amount of the brochure given to pictures or information tables, and decimals to calculate overall costs.

Learners could demonstrate that they can to convert to and from standard form for very large numbers and very small numbers. This could be assessed in the context of distance travelled or currency conversions.

Learners could investigate activities such as a chance game in a theme park that relies on probability. For example, someone designing a theme-park game would work out the chance of competitors winning a top prize so that it is neither too easy nor too difficult. Learners should suggest improvements in at least one area that would result in greater profitability or visitor numbers. For example, learners could use probability to show how it can be used to predict weather, visitor numbers and activities at a resort, and suggest improvements to ensure a resort focuses on activities suitable for the weather.

Learners could produce an analysis of data, for example, an analysis for a tour operator where the data has come from a brochure and/or a feasibility study for a theme park.

Learners should be able to make predictions based on data trends, for example, preparing a report to compare two airlines using price, destinations, number of passengers, or frequency of flights. Another example could be describing the increase in the number of visitors over a period of time.

Sport

Learners will be expected to demonstrate that they can use fractions, decimals and percentages. For example, an investigation of diet over a period of time could include tasks asking learners to use percentages to calculate total amounts of fat, carbohydrate and protein, fractions or percentages to compare different meal combinations and decimals to calculate overall nutritional content.

Learners must demonstrate that they can use standard form when calculating with very large or very small numbers. This could be assessed in the context of using weights or scale.

Learners could produce an analysis of data, for example, where the data has come from nutritional analysis, body composition or the Olympic Games.

Learners should contrast two situations using statistical techniques. Learners should suggest improvements in at least one area that would lead to improved results. These could arise from either nutrition or sports event project work.

Engineering

Learners must show that they can use calculations involving fractions, decimals and percentages to solve problems, for example, by investigating the costs involved in setting up a new production line or producing a report outlining brochure design, wages and commission.

Learners need to demonstrate that they can convert to and from standard form for very large numbers and very small numbers. This could be assessed in the context of distance travelled in traffic management and road design. Learners must demonstrate that they can calculate with standard form when dealing with very large or very small numbers, for example, working with different computer storage sizes Kb, Mb, Gb, and speeds of transmission such as nanoseconds. This could be assessed in the context of distance travelled in traffic management and road design.

Learners should demonstrate an understanding of the probability definitions and include examples of calculations involving combined probabilities.. This may be demonstrated by investigating electronic combinational logic gates.

Learners could produce an analysis of data, for example, where the data has come from flow rates, comparison of different materials or production techniques, comparison of different ways of generating power, or reliability and performance data relating to components such as the life-time of bearings.

Learners should make prediction based on data trends, for example, traffic management at different times of day to work out real rush-hour periods. Learners should be able to investigate fully two or more data sets. For example, using data gathered to determine sensible time-spans of traffic lights to filter traffic appropriately and quickly.

Learners should calculate the percentage error between the rounded and unrounded solutions, for example, converting between imperial and metric measurements in order to export to Europe.

Learners should suggest improvements in at least one area that would result in change such as improved reliability, or predicting maintenance activities. These could arise from either quality assurance or power generating project work. Charts, graphs and diagrams could include annual rainfall figures and reservoir levels to determine critical points, or electricity consumption during the day and evening. Learners could look at how to implement a more ecological approach in a particular industry, by comparing costs and consumptions from various energy sources.

Health and Social Care

Learners could investigate the numbers of children compared to staff within a day nursery, or the number and the different levels of staff and residents in a residential care home. Learners could calculate any discounts given by day nurseries to families with more than one child attending. Learners could use percentages to calculate numbers of children attending within each age group. After rounding appropriately, learners should calculate the percentage error between the rounded and unrounded answers.

Learners need to demonstrate that they should be able to convert to and from standard form for very large numbers and very small numbers. This could be assessed in the context of incidence of disease, population trends and demographic data, considering recommended daily allowances (RDA) of certain food products, as well as weights and scales.

Learners should be able to convert to and from metric and imperial measures, for example, height and weight measures could be used.

Learners could investigate activities such as genetic inheritance including dominant, recessive and sex-linked inheritance, for example the probability of parents giving birth to a child with a recessive disorder such as cystic fibrosis. Other examples might include investigating the probability of a particular lifestyle choice, for example smoking resulting in a life threatening disease, or the probability of children reaching a certain height in adulthood based on their parents' adult height.

Learners could produce an analysis of data, for example, using data from a survey of facilities and opening times at the local GP surgery or a comparison of facilities provided by two service providers within the Health and Social Care sector.

Learners should be able to investigate fully two or more data sets, either given or collected, and use statistical techniques and probability to give the advantages of one situation over another. An example could be preparing a report to compare two day-care facilities for a parent using price, location, facilities, number and qualifications of staff, hours of opening and so on. They should be able to justify their decision based on the advantages of one situation over the other.

Learners should make predictions based on data trends. For example, the uptake of immunisations based on the various diseases immunised against; number of teenage pregnancies; or the incidence of disease linked to changes in population status.

Learners should be able to contrast two situations using statistical techniques, for example, learners could also use probability theory to predict the number of people who may require access to care services based on lifestyle choices that cause life threatening illnesses.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the criteria in the assessment grid. This is for guidance only and it is recommended that centres either write their own assignments or adapt Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1, M2, D1	Using numerical methods	A written activity, using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to complete the task to satisfy each of the criteria, by solving a given practical problem	A report containing written solutions to contextual real-life problems, showing clear evidence of using the numerical methods appropriately, and checking that the answers are reasonable and in keeping with the vocational problem being solved
P3, M3, D2	Using probability	A written activity, using probability in the context of the vocational industry, requiring learners to complete the task to satisfy each of the criteria	A report containing written solutions to meet the requirement for using probability to compare predicted outcomes for up to two independent events, in order to solve a contextual real-life problem
P4, P5, M4, M5, D3	Using statistics	A written activity, using statistical methods, in the context of the vocational industry, requiring learners to complete the task to satisfy each of the criteria	A report containing written solutions to meet the requirement for using statistics to represent, compare and interpret two or more data sets in order to solve a contextual real-life problem

Essential resources

The nature of this course means that learners should have access to information from mathematics support materials as well as the vocational industry being covered. Information should include the internet, newspapers and relevant trade journals so the learners can research aspects of the chosen vocational industry that enable them to gain an understanding of the concepts and principles involved. Learners will also need access to mathematical equipment, including an electronic scientific calculator, a ruler, a pair of compasses and a protractor.

Indicative resource materials

For the vocational contexts of Travel and Tourism, Sport, Engineering and Health and Social Care

Travel and Tourism

Textbooks

Ian Roberts, Fiona Laing – *BTEC Introduction to Hospitality, Travel and Tourism,* (Heinemann, 2005)

Journals

Travel Weekly (www.travelweekly.co.uk)

Travel Trade Gazette

Websites

www.staruk.co.uk

www.ttglive.co.uk

Sport

Textbooks

Ray Barker, Bob Harris, Louise Sutton – *BTEC Introduction to Sport and Leisure* (Heinemann, 2005)

Engineering

Textbooks

Graham Lawler – *Understanding Maths: Basic Mathematics Explained 3rd Edition, Studymates*, (Aber Publishing, April 2006)
Jenny Olive – *Maths: a Student's Survival Guide (A Self-help Workbook for Science and Engineering Students)*, (Cambridge University Press, Sept 2003)
Richard C. Spangler, John Boyce – *Mathematics for Technical and Vocational Students: A Worktext,* (Prentice Hall, 2nd Edition, March 2000)

Journals

A range of journals can be found at this site
http://www.sagepub.co.uk/journals.nav?level1=V00&currTree=Subjects&

Websites

The Institution of Engineering and Technology	http://www.theiet.org/
Flipside Extra	http://www.flipside.org.uk/

Health and Social care

Textbooks

Lynda Mason, Jo Irvine & Sarah Horne – *BTEC Introduction to Health and Social Care,* (Heinemann, 2004)

Journals

Community Care	www. communitycare.co.uk
Nursery World	
Nursing Times	www.nursingtimes.net

Websites

Department of Health	www.dh.gov.uk
National Institute for Clinical Excellence	www.nice.org.uk
National Statistics	www.statistics.gov.uk

Unit 2: Applications of Geometry, Measures, Number and Algebra in Vocational Roles

Unit code: A/601/9210

Level: 2

Credit value: 4

Guided learning hours: 40

Unit aim

The aim of this unit is to enable learners to solve mathematical problems in a range of different vocational roles. They will develop skills in using transformations of shape, scale drawings, linear equations, ratio and proportion and using measures.

Unit introduction

This unit provides learners with an opportunity to develop their understanding of two dimensional (2-D) shapes and three dimensional (3-D) shapes to enable them to make decisions about the properties of the shape, its area and its volume.

Learners will investigate properties of geometry and measures, and should be able to use the experience gained to make estimates of simple dimensions and shapes and also to express solutions with the appropriate degree of accuracy. This unit also provides for extending learners' understanding of the properties of shape to include enlargement.

Learners will use scale in order to make diagrams an appropriate size; will analyse scale drawings to determine values; and use scale in graphical solutions to problems. It is also useful for learners, at the higher end of the qualification, to gain an understanding of the application of angle, loci and triangle construction.

The unit introduces equations, and learners will use formulae relating to shape in order to solve problems.

Learners will construct formulae from information in words and diagrams, and will also substitute values in given formulae to obtain solutions. The unit also explores direct and indirect proportion within a practical situation.

The unit provides learners with opportunities to develop their problem-solving skills through a vocational context, enabling the learners to see their practical applications and the importance, in the workplace, of all the skills that they have covered.

Learning outcomes

On completion of this unit a learner should:

1 be able to use the properties of shape to solve a problem in real-life contexts

2 be able to use numeric and algebraic techniques to solve a real-life problem in context

3 be able to solve a non-routine problem in real-life context using measures

Unit content

1 Be able to use the properties of shape to solve a problem in real-life contexts

2-D shapes: circles; triangles (eg isosceles, scalene, equilateral, right angle); quadrilaterals (eg square, rectangle, parallelogram, trapezium, rhombus); other polygons (eg pentagon, hexagon, heptagon, octagon, nonagon, decagon)
3-D shapes: (eg cube, cuboid, cylinder, sphere, prism)

Properties of shapes: symmetry and angle properties of quadrilaterals and polygons, representation of 2-D and simple 3-D shapes; congruence, (eg right prisms, right pyramids, cubes, cuboids)

Construction: scale drawings; loci construction; angle construction (eg angle bisectors, perpendicular bisectors, constructing triangles using these techniques)

Transformations: enlargement (eg scale factors); reflection (2-D), rotation (2-D, angle, direction and centre); translation (eg vector)

2 Be able to use numeric and algebraic techniques to solve a real-life problem in context

Numeric techniques: standard form; unitary method for solving problems; calculation of ratios; proportional change; indirect and direct proportion (formula is not required)

Algebraic techniques: number sequences (eg worded and *n*th term); linear equations (eg one step, two step, brackets, unknowns on both sides); compound measures; changing the subject of a formula (eg linear formulae); trial and improvement; quadratic equations (eg double bracket expansion; factorisation, where for $ax^2 + bx + c$, $a = 1$); quadratic formulae

Graphical solutions: simultaneous equations; quadratic equations; understand local minimum and local maximum; solving cubics using a graph; inequalities solved graphically

3 Be able to solve a non-routine problem in real-life context using measures

2-D shapes: quadrilaterals (eg trapezium, parallelogram); compound shapes; area and circumference of circles (eg use π to three decimal places; express area in terms of π)

3-D shapes: calculation of surface area and volume of 3-D shapes (eg sphere, cube, cuboid, prism); calculation of the volume of 3-D compound shapes (use of trigonometry and Pythagoras' theorem is **not** required)

Measures: understanding accuracy and precision; appreciation of the importance of accuracy in measurement; working to two decimal places

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 Manipulate a shape by using two transformations of reflection, rotation, translation and enlargement to solve a real-life problem	M1 Produce a scale drawing to solve a real-life problem	D1 Construct diagrams accurately to solve a real-life problem
P2 Solve a real-life problem using a linear equation with two operations	M2 Use algebraic techniques to solve quadratics in context	D2 Use inequalities, direct and indirect proportions and graphical solutions to solve problems in context
P3 Solve a real-life problem using a linear equation involving brackets		
P4 Solve a real-life problem using a linear equation with the unknown on both sides of the equation		
P5 Solve a real-life problem using a linear equation with fractional coefficients		
P6 Use ratio and proportion to solve a real-life problem		

Assessment and grading criteria		
P7 Solve real-life problems by finding the circumference or the perimeter and area for three different shapes (circles, trapeziums and parallelograms)	M3 Solve problems in context using area and volume of compound shapes and solids	
P8 Solve real-life problems by finding the volumes for three different solids (spheres, cylinders and cuboids)		

Essential guidance for tutors

Delivery

This unit should primarily be classroom based, with a mixture of classroom teaching and practical examples. It should cover the mathematical content through practical examples of situations that arise in the vocational industry, and will require learners to explore areas of vocational contexts and to solve problems by using the mathematical skills that they have been taught. Learners should be encouraged to use their knowledge of mathematical applications in a holistic manner in order to solve a real-life problem in a vocational context.

Learners should be introduced to the concept of shapes and their manipulation through the four standard transformations. By using scale drawing in a vocational context, learners would be able to demonstrate effective scale drawing and give explanations of its use. By considering different dimensions of such examples, learners would be able to demonstrate enlargement, and this could be extended to include a 3-D study of their practical investigation in order to demonstrate 3-D coordinate work.

The movement of staff, resources and materials within a practical context could give rise to translation and coordinate questions. By using geometrical properties in a vocational context, shapes, tessellations, lines of best fit and relevant calculations could be considered.

Learners should meet, at the higher levels of the qualification, the knowledge and application of angle, loci and triangle construction.

Learners should attain a firm grasp of using routine formulae. At the lower levels this could be demonstrated through the use of substitution into formulae. The learner could demonstrate further algebraic manipulation techniques through the solution of equations in practical real-life problems. Graphical representation of equations could be achieved through the consideration of, for example, distance-time graphs.

Learners should develop an understanding of direct and indirect proportion within a practical situation. Direct proportion could be demonstrated through the relationships between two relative aspects of a practical problem. A comparison across different events could give rise to higher levels of proportional manipulation and prediction. Indirect proportion could be demonstrated within a vocational scenario. Learners must demonstrate at the higher levels the understanding and use of inequality relationships: this could be demonstrated through investigations of vocational contexts.

Learners should develop an ability to determine lengths, angles, perimeters, areas and volumes. Much of the content of this unit could be covered through a project that draws together these different topics. This would utilise geometric properties, the use of arc-lengths and sector areas and the drawing of nets. If the learner were to consider non-routine aspects of the investigation, an incorporation of 3-D shapes would be achieved.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Learners could be introduced to the concept of shape and the manipulation of shapes through designing the floor space of a large conference centre or a large hotel reception floor. To demonstrate enlargement, for example, the learner could compare the different dimensions of reception areas to the dimensions of the leisure areas of a hotel. By establishing a scale drawing of the floor space of a large conference centre, or a large hotel reception floor, learners would be able to demonstrate effective scale drawing.

Moving staff, resources or materials around a very large theme park, for example, Disneyland Paris or Alton Towers, could give rise to working with translation and coordinates. This could be extended further to include a 3-D study using height within a theme park. At the higher level, a comparison of two similar theme parks, in different locations, could give rise to similar shape problems, for example, comparing Disneyland Paris and Disneyworld in terms of size and layout.

By investigating airline transportation, air traffic control techniques and theme park rides, learners could meet at the higher levels of the qualification, the knowledge and application of angle, loci and triangle constructions.

Learners should be able to use routine formulae. At the lower levels this could be demonstrated through the use of substitution into formulae, for example, to calculate the food order for airlines, taking into account the number of passengers, the number of orders for meals for children and the number of orders for vegetarian meals.

The learner could demonstrate further algebraic manipulation techniques through any weight or fuel related equation, for example, an understanding and use of formulae to calculate the amount of fuel required depending on the variable weight of the plane and the luggage. This could be further extended by considering product cost (profit and loss) dependent on the weight of the plane. Graphical representation of equations could be achieved through the consideration of distance time graphs.

Direct proportion could be demonstrated through the relationships between amount of profit and the amount of money spent in a travel agency on holidays. This could be compared to currency exchange or different types of holiday for a tour operator. A comparison across different function events could give rise to higher levels of proportional manipulation and prediction, for example, a consideration of catering scenarios for a large banquet where numbers of attendees could be variable or even unknown. Indirect proportion could be demonstrated within a transport scenario, for example, the airline tactics of fuel allowance and usage. Learners must demonstrate at the higher levels the understanding and use of inequality relationships, which could be demonstrated through the measuring of food required to ensure satisfaction by customers on an airline, while also balancing profit.

Learners should develop an ability to determine lengths, angles, perimeters, areas and volumes. Most of the content of this unit could be covered through a project on the dimensions, layout and the efficiency of a hotel, incorporating fixed and movable accommodation facilities, catering facilities, business and conference facilities and leisure areas. This would give rise to properties of shapes, the use of arc-lengths and sector areas, the drawing of nets, and shape properties. If the learner were to consider theme parks, an incorporation of 3-D shapes would be achieved.

Sport

Learners should be introduced to the concept of shapes and the manipulation of shapes through designing an Olympic stadium track. By establishing a scale drawing of running track and internal field events, learners would be able to demonstrate effective scale drawing as well as explanations of its use. By considering different dimensions of competitive arenas, learners would be able to demonstrate enlargement, for example, the comparison of differing dimensions of football pitches or the differences between indoor and outdoor athletics tracks.

The study of the movement of synchronised swimmers would give rise to work involving translation, rotation and coordinates. This could be extended further to include a 3-D study of the swimmer's training routine in order to demonstrate 3-D coordinate work. At the higher level, a comparison of indoor and outdoor athletics could give rise to working with similar shapes.

Learners aiming for higher grades should demonstrate, at the higher levels of the qualification, the knowledge and application of angle, loci and triangle constructions. For example, an investigation into the difference of the actual distance travelled by a hammer and the awarded distance travelled by a hammer in a hammer throwing event.

Learners should be able to use routine formulae. At the lower levels, this could be demonstrated through the use of substitution into formulae, for example, projectile motion, or Newtonian motion formulae,

$s = ut + \frac{1}{2}at^2$ and $v = u + at$.

For example, the investigation into the best or most effective position to place a rugby ball in order to be successful with a conversion of a try in a rugby match.

The learner could demonstrate further algebraic manipulation techniques through any sports-related formulae, for example body mass index, conversion formulae, fitness-testing related formulae (i.e. body fat percentage formulae using skin fold measurements with callipers), use of the Rockport Walk Test and the scoring of VO2 max. This could be further extended by converting between units within the formulae. Graphical representation of equations could be achieved through the consideration of world record times, for example, the comparison of women's progression against their world records and those of men. An investigation into "When will women overtake men in terms of 100m world record times?" could give rise to number sequences, graphing, lines of best fit and correlation coefficients.

Learners should demonstrate an understanding of direct and indirect proportion within a practical situation. Direct proportion could be demonstrated through the relationships between the number of competitors in an international team and the accommodation costs of the team.

A comparison of different international teams and their costs could give rise to a higher level of proportional manipulation and prediction. Indirect proportion could be demonstrated within a motor-sport scenario, for example, the Formula One tactics of fuel allowance and usage. Learners must demonstrate, at the higher levels, the understanding and the use of inequality relationships. This could be demonstrated through the measuring of sub-maximal heart rates to determine approximate VO2 max, where extrapolation is required from a graph.

Learners should demonstrate an ability to determine lengths, angles, perimeters, areas and volumes. Most of the content of this unit could be established through a project on the dimensions, layout and efficiency of an Olympic stadium incorporating running track and internal field events. This could include establishing the starting lines for the differing running events and fitting in javelin, hammer, high jump and long jump areas. This would give rise to properties of shapes, the use of arc-lengths and sector areas, the drawing of nets, and shape properties. If the learner were to consider sports beyond this field, such as, swimming, an incorporation of 3-D shapes would be achieved.

Learners should show the ability to solve two different types of equation graphically, for example, simultaneous equations, cubic equations, quadratic equations or inequalities.

Engineering

Learners should be introduced to the properties of shapes within the context of engineering tools, for example, the properties of hexagonal socket wrenches, such as Allen keys and spanners and so on.

Learners should be introduced to the concept of shape, and the manipulation of shapes through the four standard transformations. This could be achieved within translation, by considering the movement of production-line robots around a large-scale factory floor; within reflection, through considering orthographic projection; within rotation, through considering the movement of plant/heavy resources by large-scale crane movement and within enlargement, through the changing of scale drawings, in particular the scale drawings of buildings.

By establishing a scale drawing of a mechanical product, learners would be able to demonstrate effective scale drawing and explanations of its use. For example, by considering shape and space techniques on waste material cut from metal plates, shapes, tessellations, best fit, and calculations of waste material could be considered.

Learners should be able to demonstrate enlargement, for example, in comparison of differing dimensions of international Formula One race tracks. This could be developed to include all aspects of transformations. The movement of materials and resources around a factory on its conveyor belt or production line could also give rise to translation, rotation and coordinate work. This could be extended further to include a 3-D study of the factory or production line in order to demonstrate 3-D coordinate work.

Learners should demonstrate, at the higher levels of the qualification, the knowledge and application of angle, loci and triangle constructions, for example, by considering the balancing of rotating shafts or a consideration of the power transmission by gears and pulleys.

Learners should be able to use routine formulae. At the lower levels, this could be demonstrated through the use of substitution into formulae, for example, by using $V = IR$, or Newtonian motion formulae,

$s = ut + \frac{1}{2}\ \mathrm{at}^2$ and $v = u + at$.

By using the equations of motion in a mechanical engineering context, or in an electrical engineering context, the use of algebra and algebraic manipulation can be achieved at this level.

The learner could demonstrate algebraic manipulation techniques through any mechanical engineering, large scale manufacturing or electrical engineering related formulae. Graphical representation of equations could be achieved through the

consideration of distance-time, and velocity-time considerations within the motor engineering industry.

Learners should demonstrate an understanding of direct and indirect proportion within a practical situation. Direct proportion could be demonstrated through the relationships between the resistance of conductors and its cross-sectional areas.

Indirect proportion could be demonstrated within a gear and cog application. Inverse proportion could also be achieved through a small-scale research project into the product efficiency (cost and time spent) of a resource, which is designed within tolerance. Learners must demonstrate at the higher levels the understanding and use of inequality relationships. This could be demonstrated through the consideration of practical engineering rounding, for example, within motor engineering, a consideration of maximum and minimum values and the tolerances that need to be allowed for the successful completion of an experiment.

Learners should demonstrate an ability to determine lengths, angles, perimeters, areas and volumes. Much of the content of this unit could be established through the consideration of storage containers. For example, learners could undertake a research project into the most efficient shape for product efficiency, which could be a circle, as it gives the best cross sectional area for the least material used. Learners could consider measures in terms of wire, guttering and so on.

At the higher levels, this could include the use of arc-lengths and sector areas, the drawing of nets and geometry properties. If the learner were to consider large-scale manufacturing, such as in the aviation industry, then an incorporation of 3-D shapes would be achieved.

Health and Social Care

Learners could be introduced to the concept of shapes and the manipulation of shapes through the four standard transformations. This could be achieved within the context of designing a day nursery layout or the layout for the ground floor of a residential care home. By establishing a scale drawing of the floor space, learners would be able to demonstrate effective scale drawing and explanations of its use. By considering the different dimensions of such examples, learners would be able to demonstrate enlargement. This could be done by considering the dimensions of work tables and pieces of equipment within a classroom, or the differences between the wet/messy play area and the quiet area within a scale drawing and relating these to actual size. The movement of equipment from an inside play area to an outside area could give rise to translation. At the higher level, learners could compare the layout in terms of space and equipment of two different day-nursery floor plans or outdoor play areas, to consider a variety of shape problems. This would also enable learners to consider the use of quadratic equations when comparing the area available and the best design.

Learners should be able to use routine formulae. At the lower levels this could be demonstrated through the use of substitution into formulae, for example calculating the number of litres of milk required each day, dependent on the number of children attending the day nursery each day.

Learners could demonstrate further algebraic manipulation techniques by using physical measures of health, for example, understanding and using the body mass index formula and conversion formulae. This could be further extended by converting between types of unit. Graphical representation of equations could be achieved through the consideration of centile charts for height and weight, and body mass index charts, where learners could be encouraged to compare their results against the normal, and the incidence of disease or lifestyle choices related to age or gender. An investigation into the height and weight of a group of children

of the same age could give rise to number sequences, graphing, lines of best fit and correlation coefficients.

Learners should develop an understanding of direct and indirect proportion within a practical situation. Direct proportion could be demonstrated by calculating the number of sessions that a child attends in nursery, and the cost of the childcare. A comparison across different age-groups could give rise to higher levels of proportional manipulation and prediction. Indirect proportion could be demonstrated within a residential care home, for example by comparing the time taken to make 30 beds with the number of staff available or by considering the uptake of immunisations compared to the incidence of disease. Learners must demonstrate, at the higher levels, an understanding and the use of inequality relationships. This could be demonstrated through determining staffing levels to achieve the optimum time to make the beds, compared to the cost of employing those staff as well as balancing the profit.

Learners should determine lengths, angles, perimeters, areas and volumes. Much of the unit content could be covered through a project on dimensions, layout, efficiency and safety of a childcare setting such as a day-nursery, incorporating fixed and moveable accommodation facilities, catering facilities, and play areas to meet the different types of play required. This would give rise to properties of shapes, the use of arc-lengths, and sector areas and the drawing of nets. Consideration of an outside play area or a soft play area providing a range of climbing equipment, would involve using 3-D shapes. Loci and constructions could be met through consideration of ramps, door sizes and pathways for disabled access.

Learners aiming for higher grades should demonstrate, at the higher levels of the qualification, the knowledge and application of angle, loci and triangle construction.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole class teaching: • introduction to unit content, scheme of work and assessment strategy • tutor-led revision of the properties of shape, number of sides, number of equal sides, number of parallel sides, size of angles, number of equal angles, lines of symmetry and order of rotation • explain properties of transformations (reflection, rotation and translation) • extend to include enlargements • explain scale drawings and uses • explain how to accurately construct diagrams Individual learner activity: • tasks and activities using transformations and enlargements • tasks and activities using scale drawings and accurate construction of diagrams
Prepare for and carry out assignment 1 (P1, M1, D1)
Whole class teaching: • tutor-led revision of the rules of algebra, including the order of operations, simplification of algebraic expressions, expansion of brackets, the construction of formulae and the solution of routine linear equations involving two operations • extend to include the solution of linear equations for non-routine problems, where at least two operations are involved • explain how to solve linear equations involving brackets, with unknowns on both sides of the equal signs and having fractional coefficients • extend to include solving quadratic equations Individual learner activity • tasks and activities involving solving linear and quadratic equations Whole class teaching: • explain ratio and proportion • explain solving inequalities • explain how to solve equations graphically Individual learner activity: • tasks and activities using ratio, proportion, inequalities and finding graphical solutions
Prepare for and carry out assignment 1 (P2, P3, P4, P5, P6, M2, D2)

Topic and suggested assignments/activities and/assessment
Whole class teaching: • tutor-led revision of the properties of shape, including areas and volume of compound shapes • extend to include the areas of a circle, trapezium and parallelogram • explain how to find the volume of a cuboid, cylinder and sphere • extend to include finding areas and volumes of compound shapes and solids Individual learner activity: • tasks and activities finding and using areas and volumes of compound shapes and solids
Prepare for and carry out assignment 1 (P7, P8, M3)

Assessment

Assessment could be through tasks that allow the learner to demonstrate that they meet the criteria in one or more areas. The assignments should be focused on topics within a vocational industry where the contexts give rise to data most suited to the higher-level skills.

In order to achieve P1, learners must show that they can manipulate shapes through two transformations chosen from translation, rotation, reflection and enlargement. This can be demonstrated within the context of a vocational investigation. Learners should show how the area or volume of a shape changes following a transformation. Learners should be able to identify congruent shapes, where appropriate, following transformations.

Learners must demonstrate that they can solve linear equations, and this could be in relation to solving practical problems. Learners should solve four equations. This should involve equations requiring at least two operations for P2; for P3, involving brackets, and for P4, unknowns on both sides. At least one equation should involve fractional coefficients, for P5.

To achieve P6, learners need to demonstrate the use of ratio and proportion. They should show that they can divide quantities into ratios and proportions, simplify ratios and find the total amount from a proportion. They should use each skill at least twice.

For P7, learners need to demonstrate the solution of routine perimeter, or circumference, and area problems for three different shapes, one of each of, circles, trapeziums and parallelograms. For P8, learners also need to be able to find the volume for three different shapes, one of each of, cuboids, cylinders and spheres. This could be demonstrated in context through an extended vocational project.

To achieve M1, learners must accurately use all four transformations and give detail of scale drawings within an explanation of how they achieved the end result. It would be expected that learners demonstrate multistage transformations, for example enlargement combined with a translation, and use their understanding of scale, ratio and proportion to relate their drawing to real life. Learners should show how area, perimeter or volume of the shapes has changed after their transformations.

For M2, learners would be expected to extend their work in P2, P3, P4 and P5 to quadratic equations. For example, deriving and solving the equation which describes a context relevant in a vocational industry. Learners should set up and solve three quadratic equations.

For M3, measures would include compound shapes, using a cross-section if to remain at 2-D level. An explanation of accuracy and precision would also be included. Learners should find the area of two compound shapes and the volume of two compound solids.

To achieve D1, learners should be able to construct shapes for a scale diagram accurately using compasses and a ruler, showing construction lines and scale. Learners should construct a triangle, a perpendicular or angle bisector and one locus.

To achieve D2, learners should show indirect proportion by using a graph to predict three unknown values. Learners should also show the use of two different types of equation solved graphically, for example, solving simultaneous equations, cubic equations, quadratic equations or inequalities.

The following headings cover a few examples of vocational areas that can be used to develop the necessary mathematical skills. This is not an exhaustive list and other vocational examples could include business, ICT, hair and beauty, retail and so on.

Travel and Tourism

Assessment could be through tasks such as tour operators, theme parks or other attractions, transport and/or accommodation providers and travel agents, as these give rise to data most suited to the higher-level skills.

Learners must show that they can manipulate shapes through two chosen from translation, rotation, reflection and enlargement. This can be demonstrated within the context of a travel agent's office design. Learners must be able to use all four transformations and be able to draw scale diagrams with an explanation of how they achieved the end result. This could be done through extending their investigation of the design of a travel agency.

Learners need to be able to work out the perimeter, area and volume for three different shapes. This could be demonstrated in context, for example, through an extended project on theme park design. Working with measures would include compound shapes, for example, calculations involving a new holiday centre's swimming pool (cross section if to remain at 2-D level).

Learners should be able to accurately construct shapes for a scale diagram using a pair of compasses and a ruler. For example, learners could construct a scale diagram of a swimming pool, showing construction lines and scale.

Learners must demonstrate that they can solve linear equations and this could be done, for example, by calculating of the selling price of a holiday for a tour operator or by calculating the marginal selling price of last minute accommodation. Learners would be expected to extend their work on equations to include quadratic equations. For example, deriving and solving the equation which describes the number of tables which can be placed in a conference room, considering area of the room and the tables, the amount of space required for seating and the number of people in the room.

Learners need to demonstrate the use of ratio and proportion, for example, by showing how 200 guests in a hotel conference can be seated in three conference rooms, with each room having a different maximum capacity, by finding the ratio of guests to rooms and simplifying this ratio or by finding how many dive leaders for thirty divers are needed, if a ratio of 1 dive leader to 4 divers is a health and safety requirement.

Learners should be able to use a graph to solve an indirect proportion problem. For example, if the number of visitors to a resort is indirectly proportional to the average price per person per night, they could use a graph to generate the relationship for this and to demonstrate that the formula is correct.

Sport

Assessment should be through tasks such as training programmes, sports events (with focus on multi-disciplined events), nutritional analysis, fitness testing programmes and using projectile motion. Using these contexts will enable the learners to gain access to higher level skills.

Learners must show that they can manipulate shapes through two chosen from reflection, rotation, translation and enlargement. This can be demonstrated within the context of a stadium design. Learners must accurately use all four transformations and give detail of scale drawings with an explanation of how they achieved the end result. This could be done through extending their investigation of the design of a sports stadium. Learners should be able to accurately construct shapes for a diagram using a pair of compasses and a ruler. For example, construct an accurate scale diagram of an athletics area, including a running track and a triangular hammer area. Learners need to demonstrate the use of routine perimeter, area and volume formulae for three different shapes. This could be demonstrated in context through an extended project on stadium design. Measures include compound shapes, for example, calculations involving a new holiday centre's swimming pool (cross-section if to remain at 2-D level).

Learners would be expected to extend their work on equations to include quadratic equations. For example, deriving the equation for the arc of a golf ball shot, using

$s = ut + \frac{1}{2}at^2$ and solving for values of t and s.

Learners should also establish and use indirect proportion to show relationship between variables. Learners need to be able to demonstrate the use of ratio and proportion graphically. Learners should show that they can divide quantities into ratios and proportions, simplify ratios and find the total amount from a proportion. For example, by finding the ratios of spectators in different stands in a stadium, by finding how many coaches are needed given a ratio of players to coaches, or by finding the total number of spectators at an event given a ratio. Direct proportion could be demonstrated, for example, by showing that the average time an athlete takes to complete a race is directly proportional to the length of the track.

Learners should also establish and use indirect proportion to show relationships between variables. For example, deriving an equation where the time it takes an athlete to recover from an injury is indirectly proportional to the time since the last injury.

Engineering

Assessment could be through tasks within the engineering industry sector or large scale manufacturing. By considering large scale manufacturing and production it will allow the learner to access material in greater depth, by using research, and this will enable learners to gain access to higher-level skills.

Learners must show that they can manipulate shapes through two chosen from reflection, rotation, translation and enlargement. This can be demonstrated within the context of drawings of mechanical components. Learners must accurately use all four transformations and show scale drawings with an explanation of how they achieved the end result. This could be done through extending their investigation of drawings of mechanical components.

Learners need to demonstrate the use of routine perimeter, area and volume for three different shapes. This could be demonstrated in context through an engineering plant consideration. Learners should be able to accurately construct shapes for a diagram using a pair of compasses and a ruler. An example of doing this could be in the development of products in 2-D then converting these to 3-D, building on activities previously carried out. Working with measures includes compound shapes, for example, calculations involving a volume level tank (use cross section to remain at 2-D level).

Learners would be expected to extend their work on equations to include quadratic equations. Higher level use of the regular formulae would be expected, for example, in the areas of motion, fluid mechanics and so on.

Learners need to demonstrate the use of ratio and proportion, for example through the use of developing small models to demonstrate full-scale constructions – such as those used by architects to promote new developments.

Health and Social Care

Assessment could be through tasks involving childcare providers or health clinics, as these give rise to data most suited to the higher-level skills.

Learners must show that they can manipulate shapes through two chosen from translation, rotation, reflection and enlargement. This can be demonstrated within the context of the design of a day-nursery. Learners must use all four transformations accurately and give details of scale drawings with an explanation of how they achieved the end result. Learners need to demonstrate the use of the perimeter, area and perimeter for three different shapes. This could be demonstrated in context through an extended project on a day-nursery design, for example, by considering climbing or soft play equipment or storage facilities. Working with measures would include compound shapes, for example, the calculations involving a variety of shaped cushions for a new sensory room within a school for children with special educational needs; or a new soft play area within a day-nursery. Learners should be able to accurately construct shapes for a scale diagram using compasses and a ruler, for example, to accurately construct a scale diagram of a sensory room or soft play area, showing construction lines and scale.

Learners must demonstrate that they can solve linear equations. This could be in relation to calculating the cost of childcare, for example if the cost of childcare is directly proportional to the number of hours of care required. Learners would be expected to extend their work on equations to include quadratic equations. For example, deriving and solving the equation which describes the number of desks/tables which can be placed in a nursery classroom, considering the area of the room and the area of the tables, the amount of space required for seating and the number of adults and children in the room, or perhaps, the design of an outside play area.

Learners need to demonstrate the use of ratio and proportion. For example, 200 patients in a hospital can be accommodated in 12 wards, each with a different maximum capacity. Learners could find the ratio of patients to wards and simplify this ratio or learners could find out how many nursery nurses must be on duty for 60 children of varying ages; as defined in the National Day Care Standards.

Learners should show indirect proportion using a graph and use it to predict three unknown values. For example, if the number of immunisations given to children is indirectly proportional to the incidence of a disease immunised against, to use a graph to generate the relationship for this and demonstrate that the formula is correct.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the criteria in the assessment grid. This is for guidance only and it is recommended that centres either write their own assignments or adapt Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Using properties of shape	A written activity, using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to use the properties of shape; for example reflection, rotation, translation and enlargement and the use of scale drawings to solve a practical problem in a vocational context	A report containing written solutions to satisfy the properties of shape; for example reflection, rotation, translation and enlargement and the use of scale drawings appropriate to the contextual real-life problem, within the vocational industry
P2, P3, P4, P5, P6, M2, D2	Using number and algebra	A written activity using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to use number and algebraic skills (linear and quadratic equations, ratio and proportion, inequalities and graphical solutions) to solve a real-life problem in a vocational context	A report containing written solutions to the use of number and algebra (linear and quadratic equations, ratio and proportion, inequalities and graphical solutions) to solve a contextual real-life problem within a vocational industry

Criteria covered	Assignment title	Scenario	Assessment method
P7, P8, M3	Using measures	A written activity, using a real-life context appropriate to the learners' chosen vocational industry, requiring learners to use areas and volumes of compound shapes and solids to solve a practical problem in a vocational context	A report containing written solutions to satisfy the properties of area and volume of compound shapes and solids appropriate to the contextual real-life problem, within the vocational industry

Essential resources

The nature of this course means that learners should have access to information from mathematics support materials as well as the vocational industry being covered. Information should include the internet, newspapers and relevant trade journals so that the learners can research aspects of the chosen vocational industry that enable them to gain an understanding of the concepts and principles involved. Learners will also need access to mathematical equipment including an electronic scientific calculator, a ruler, a pair of compasses and a protractor.

Indicative resource materials

For the vocational contexts of Travel and Tourism, Sport, Engineering and Health and Social Care

Travel and Tourism

Textbooks

Ian Roberts, Fiona Laing – *BTEC Introduction to Hospitality,Travel and Tourism*, (Heinemann, 2005)

Journals

Travel Weekly (www.travelweekly.co.uk)

Travel Trade Gazette

Websites

www.staruk.co.uk

www.ttglive.co.uk

Sport

Textbooks

Ray Barker, Bob Harris, Louise Sutton – *BTEC Introduction to Sport and Leisure* (Heinemann, 2005)

Engineering

Textbooks

Graham Lawler – *Understanding Maths: Basic Mathematics Explained 3rd Edition, Studymates*, (Aber Publishing, April 2006)

Jenny Olive – *Maths: a Student's Survival Guide (A Self-help Workbook for Science and Engineering Students*), (Cambridge University Press, Sept 2003)

Richard C. Spangler, John Boyce – *Mathematics for Technical and Vocational Students: A Worktext*, (Prentice Hall, 2nd Edition, March 2000)

Journals

A range of journals can be found at this site
http://www.sagepub.co.uk/journals.nav?level1=V00&currTree=Subjects&

Websites

The Institution of Engineering and Technology	http://www.theiet.org/
Flipside Extra	http://www.flipside.org.uk/

Health and Social care

Textbooks

Lynda Mason, Jo Irvine & Sarah Horne – *BTEC Introduction to Health and Social Care,* (Heinemann, 2004)

Journals

Community Care	www. communitycare.co.uk
Nursery World	
Nursing Times	www.nursingtimes.net

Websites

Department of Health	www.dh.gov.uk
National Institute for Clinical Excellence	www.nice.org.uk
National Statistics	www.statistics.gov.uk

Further information and useful publications

To get in touch with us visit our 'Contact us' pages:

- Edexcel, BTEC and Pearson Work Based Learning contact details: qualifications.pearson.com/en/support/contact-us.html
- books, software and online resources for UK schools and colleges: www.pearsonschoolsandfecolleges.co.uk

Key publications:

- *Adjustments for candidates with disabilities and learning difficulties, Access and Arrangements and Reasonable Adjustments, General and Vocational qualifications* (Joint Council for Qualifications (JCQ))
- *Supplementary guidance for reasonable adjustments and special consideration in vocational internally assessed units* (Pearson)
- *General and Vocational qualifications, Suspected Malpractice in Examination and Assessments: Policies and Procedures* (JCQ)
- *Equality Policy* (Pearson)
- *Recognition of Prior Learning Policy and Process* (Pearson)
- *UK Information Manual* (Pearson)
- *BTEC UK Quality Assurance Centre Handbook*

All of these publications are available on our website.

Publications on the quality assurance of BTEC qualifications are also available on our website.

Our publications catalogue lists all the material available to support our qualifications. To access the catalogue and order publications, please visit our website.

Additional resources

If you need further learning and teaching materials to support planning and delivery for your learners, there is a wide range of BTEC resources available.

Any publisher can seek endorsement for their resources and, if they are successful, we will list their BTEC resources on our website.

Professional development and training

Pearson supports UK and international customers with training related to BTEC qualifications. This support is available through a choice of training options offered on our website.

The support we offer focuses on a range of issues, such as:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing learner-centred learning and teaching approaches
- building in effective and efficient quality assurance systems.

The national programme of training we offer is on our website. You can request centre-based training through the website or you can contact one of our advisers in the Training from Pearson UK team via Customer Services to discuss your training needs.

BTEC training and support for the lifetime of the qualifications

Training and networks: our training programme ranges from free introductory events through sector-specific opportunities to detailed training on all aspects of delivery, assignments and assessment. We also host some regional network events to allow you to share your experiences, ideas and best practice with other BTEC colleagues in your region.

Regional support: our team of Curriculum Development Managers and Curriculum Support Consultants, based around the country, are responsible for providing advice and support in centres. They can help you with planning and curriculum developments.

To get in touch with our dedicated support teams please visit our website.

Your Pearson support team

Whether you want to talk to a sector specialist, browse online or submit your query for an individual response, there's someone in our Pearson support team to help you whenever – and however – you need:

- Subject Advisors: find out more about our subject advisor team – immediate, reliable support from a fellow subject expert
- Ask the Expert: submit your question online to our Ask the Expert online service and we will make sure your query is handled by a subject specialist.

Please visit our website at qualifications.pearson.com/en/support/contact-us.html

Annexe A

The Pearson qualification framework for the Mathematics sector

Progression opportunities within the framework.

Level	General qualifications	BTEC specialist courses	Functional Skills
8			
7			
6			
5			
4			
3	AS Level, A Level: Mathematics Further Mathematics Further Mathematics (additional) Pure Mathematics		
2	GCSE Mathematics GCSE Statistics	BTEC Level 2 Award in Mathematical Applications	Functional Skills Mathematics
1		BTEC Level 1 Award in Mathematical Applications	Functional Skills Mathematics
Entry			Functional Skills Mathematics

Annexe B

Wider curriculum mapping

Study of the Pearson BTEC Level 1 and Level 2 qualifications gives learners opportunities to develop an understanding of spiritual, moral, ethical, social and cultural issues as well as an awareness of citizenship, environmental issues, European developments, health and safety considerations and equal opportunities issues.

Spiritual, moral, ethical, social and cultural issues

Throughout the delivery of these qualifications learners will have the opportunity to actively participate in different kinds of decision making. They will have to consider fair and unfair situations and explore how to resolve conflict. Working in small groups they will learn how to respect and value others' beliefs, backgrounds and traditions.

Citizenship

Learners undertaking these qualifications will have the opportunity to develop their understanding of citizenship issues.

Environmental issues

Developing a responsible attitude towards the care of the environment is an integral part of this qualification. Learners are encouraged to minimise waste and discuss controversial issues.

European developments

Much of the content of the qualification applies throughout Europe, even though the delivery is in a UK context.

Health and safety considerations

Health and safety is embedded within many of the units in this qualification. Learners will consider their own health and safety at work, how to identify risks and hazards and how to minimise those risks.

Equal opportunities issues

There will be opportunities throughout this qualification to explore different kinds or rights and how these affect both individuals and communities for example learners will consider their rights at work and the rights of employers and how these rights affect the work community.

Annexe C

Access arrangements and reasonable adjustments

Pearson's policy on access arrangements and special considerations for the BTEC Award in Mathematical Applications, aims to enhance access to the qualifications for students with disabilities and other difficulties (as defined by the Equality Act 2010) without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Pearson website (qualifications.pearson.com) for information about the Equality Act 2010.

Candidates can have access to all forms of equipment, software and practical assistance, such as a reader or a scribe, that reflect their normal way of working, provided that these do not affect the reliability or validity of assessment outcomes or give the candidate an assessment advantage over other candidates undertaking the same or similar assessments.

Access Arrangements	Yes/No	Type of Assessment
Extra time	Yes	Portfolio
Reader	Yes	Portfolio
Oral Language Modifier	Yes	Portfolio
Sign Language Interpreter	Yes	Portfolio
Scribe	Yes	Portfolio
Word Processor	Yes	Portfolio
Transcript	Yes	Portfolio
Practical Assistant	Yes	Portfolio
Modified Assignment/Task Papers(including Braille)	Yes	Portfolio
Models, visual/tactile aids, speaking scales	Yes	Portfolio

Annexe D

Mapping to Level 1 Functional Skills

Learners may practice functional skills within the context of this qualification. However, each qualification must be assessed separately.

Level 1	Unit number	
Mathematics – learners can:	**1**	**2**
Understand practical problems in familiar and unfamiliar contexts and situations, some of which are non-routine	√	√
Identify and obtain necessary information to tackle the problem	√	√
Select and apply mathematics in an organised way to find solutions to practical problems for different purposes	√	√
Use appropriate checking procedures at each stage	√	√
Interpret and communicate solutions to practical problems, drawing simple conclusions and giving explanations	√	√

Mapping to Level 2 Functional Skills

Learners may practice functional skills within the context of this qualification. However, each qualification must be assessed separately.

Level 2	Unit number	
Mathematics – learners can:	**1**	**2**
Understand routine and non-routine problems in familiar and non-familiar contexts and situations	√	√
Identify the situation or problems and identify the mathematical methods needed to solve them	√	√
Choose from a range of mathematics to solve problems	√	√
Apply a range of mathematics to find solutions	√	√
Use appropriate checking procedures and evaluate their effectiveness at each stage	√	√
Interpret and communicate solutions to multi-stage practical problems in familiar and unfamiliar contexts and situations	√	√
Draw conclusions and provide mathematical justifications	√	√

Annexe E

Glossary of Accreditation Terminology

The following information about these qualifications can also be found on the Pearson website.

Accreditation start/end date	The first/last dates that Pearson can register learners for a qualification.
Certification end date	The last date on which a certificate may be issued by Pearson.
Credit value	All units have a credit value. The minimum credit value that may be determined for a unit is one, and credits can only be awarded in whole numbers. Learners will be awarded credits for the successful completion of whole units.
Guided Learning Hours (GLH)	Guided Learning Hours (GLH) is the number of hours that a centre delivering the qualification needs to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, for example lectures, tutorials, online instruction and supervised study.
Learning Aims Database	Link to the Learning Aims Database, which features detailed funding information by specific learning aim reference.
Learning Aim Reference	Unique reference number given to the qualification by the funding authorities on accreditation.
Level	All units and qualifications have a level assigned to them. The level assigned is informed by the level descriptors defined by Ofqual, the qualifications regulator.
Performance tables	These qualifications are listed on the Department for Education (DfE) website School and College Achievement and Attainment Tables (SCAAT) as performance indicators for schools and colleges.
Qualification Number (QN)	Unique reference number given to the qualification by the regulatory authorities on accreditation.
Register of Regulated Qualifications	Link to the entry on the Register of Regulated Qualifications for a particular qualification. This database features detailed accreditation information for the particular qualification.
Section 96	Section 96 is a section of the Learning and Skills Act 2000. This shows for which age ranges the qualification is publicly funded for under-19 learners.

Section 97	Section 97 is a section of the Learning and Skills Act 2000. This shows whether the qualification is publicly funded for learners aged 19 and over.
Title	The accredited title of the qualification.
UCAS points	These qualification(s) are listed on the Universities and Colleges Admissions Service (UCAS) tariff for those wishing to progress to higher education.

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