edexcel
advancing learning, changing lives

GCSE

Mathematics

Assessment guidance

GCSE in Mathematics

For first teaching from September 2010

Issue 2

A PEARSON COMPANY

Contents

Section 1: Teaching functional skills at Key Stage 3 1

Section 2: Overview of new areas of testing at GCSE 13

Section 3: Functional elements and exemplar questions for GCSE 15

Section 4: Further examples of questions addressing functional elements at GCSE 21

Section 5: The assessment objectives and exemplar questions 27

Section 6: Quality of Written Communication (QWC) 33

Appendices 35

Appendix 1 37

Appendix 2 39

Appendix 3 41

Section 1: Teaching functional skills at Key Stage 3

This section focuses on the introduction of Functional Skills into KS3. As will be argued, enhancing performance at GCSE will partly be dependent on acquisition by the students of functional skills, and this process should start before the GCSE course begins, that is during Key Stage 3.

When the new National Curriculum was introduced in September 2008 it meant a revision of approach for teachers of KS3 mathematics. Not only were there some changes in content, but perhaps more importantly a change in focus, with a drawing together of some key skills across the whole curriculum. These themes encapsulated thoughts relating to Functional Skills (FS), and Personal, Learning and Thinking skills (PLTS).

These themes in mathematics are designed to create opportunities for learners to develop as self-managers, creative thinkers, reflective learners, problem-solvers, team workers, independent learners, and effective communicators. These are not new, for many years teachers of mathematics have encouraged students to undertake tasks in lessons which encourage the development of such skills. The changes in the National Curriculum have formalised these approaches to build on good practice.

In preparing students for the new GCSE mathematics examinations from 2010, where functional elements are embedded, it is therefore essential to start this process of preparation from Year 7, embedding Functional Elements and PLTS within normal lessons. This is not a 'bolt on': students will only learn these skills through regular practice. Later in this booklet much more will be said about how Functionality relates specifically to GCSE mathematics examinations. This section will focus more on the longer term preparation for GCSE, though the introduction and use of curriculum changes, or re-emphasising practices already in place.

A flexible approach

The PLTS framework comprises of six groups of skills that, together with functional skills, are essential to succeed at learning. Thus students should be taught to be:

- independent enquirers
- creative thinkers
- reflective learners
- team workers
- self-managers
- effective participators.

Together these would suggest a flexible approach when introducing work and tasks related to functional skills. Some of these tasks should be focussed on group work, students working in teams, contributing their collective expertise. Some tasks should be attempted in teams working competitively. Other tasks might be done by individuals, but should encourage participation. A good variety of tasks will offer a range of opportunities, including creativity, reflection, and independent enquiry.

Many of these skills underpin the three elements that go together to define functionality:

- **Representing**
- **Analysing**
- **Interpreting**.

(see *Appendix 2*)

There is a misconception that functionality relates to problems set 'in real life contexts'. This is not necessarily the case. There are problems which are mathematical alone, which are not necessarily related to a context in real life, but which nevertheless relate to one or more functional skills, and give opportunity for PLTS.

Some problems that are related to Functionality might be based around a particular topic that has been taught, but others might require simple problem-solving techniques.

Early Beginnings

Problem 1

The table shows the top ten tunes for the week after Christmas, and the change in their position in the top 10 charts.

Tune	Artist	Position	Change from previous week
The Climb	Joe Mcelderry	1	+1
Killing in the Name	Rage Against The Machine	2	-1
Bad Romance	Lady Gaga	3	0
3 Words	Cheryl Cole	4	+3
Star struck	Katy Perry	5	0
Meet me half way	Black Eyed Peas	6	+4
Don’t Stop Believin’	Journey	7	+2
Russian Roulette	Rihanna	8	0
You Know Me	Robbie Williams	9	-3
Children in need	Peter Kay	10	-6

Can you write out the chart list as it was during Christmas week?

This is a relatively simple problem, which could be tackled individually or in small groups. Using and ordering negative numbers in this way can be applied to other ordered lists. This is an example of a simple functional problem that could be used with lower ability groups, or perhaps a Year 7 class beginning to explore different types of problems.

There are some FS analysing skills in this problem, and some PLTS reflective skills in working out the nature of the problem.

Organisation and Presentation

Much of functionality is about getting organised to solve a problem. Students may therefore need experience of some tasks where they have to think for themselves. This could involve organising how to solve a problem and also how to present any solutions.

Problem 2

This problem is about organising a league. 22 teams play in a league. Every team will play all the other teams twice: once at home, and once away. You need to plan how many matches will be involved. It may be useful to give the teams names, or letter them A, B, C, etc.

It might be useful to start with a smaller number of teams first. How will you present the result of the problem?

Extension

– Given a calendar, and the fact that the teams play only on a Sunday, can they come up with a fixture list with dates? How will it be presented? Could a booklet be prepared for printing and distribution?

This problem is better tackled in small groups, where some discussion can take place.

There is opportunity for most of the PLTS skills here, particularly if students are working in groups to solve the problem. FS skills of representing and interpreting are also in evidence.

How much support should the teacher give the students?

It would speed up the solution if the teacher issued a grid to record the games on.

However, if students are to gain skills related to functionality and PLTS then they must spend more time learning themselves, and deciding the structure and process of solving a problem. Teachers can encourage, but not necessarily offer easier routes to solutions. Working in groups will enable students to gain from discussion. The choice of who is in each group may assist in students learning, and this is where the teacher's expertise could assist.

Peer learning is also important. Sometimes students learn from each other, and this can be encouraged. Monitor who is effective in the groupsand ensure all students have the opportunity to contribute. Assessing how effective each member of each group is will assist in putting the groups together again for the next problem.

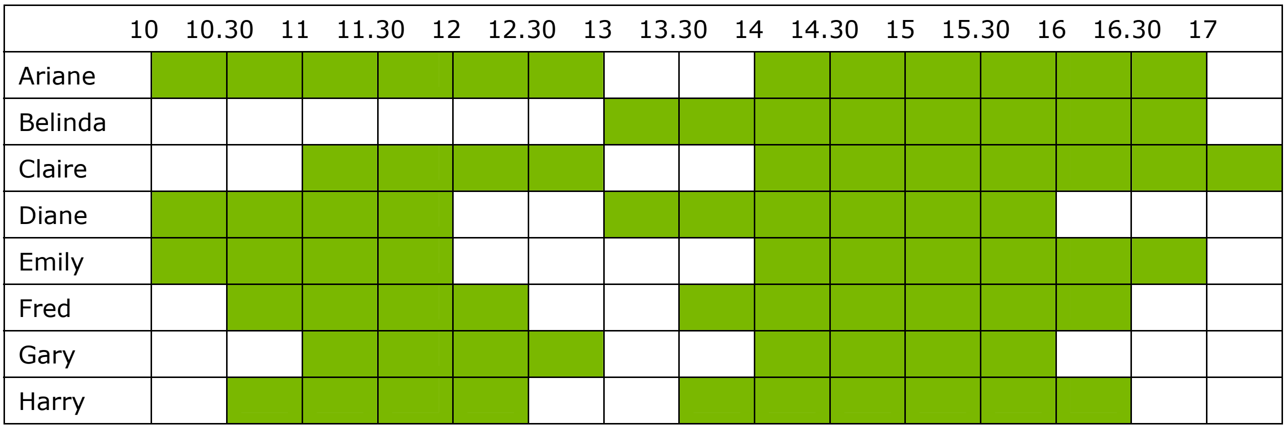
When working in groups it is also important to ensure that the groups have an opportunity to share their views, and even offer advice. This could be done in a plenary session. The teacher may need to structure the lesson to allow time for such an activity. This is not only an opportunity for groups to share ideas, but also to act as a critical friend.

Diagnostic tasks

Some tasks may be used diagnostically: use of them shows where students have weaknesses. This then allows the teacher to plan appropriate lessons as part of the course.

Problem 3

In a shop there are five women and three men. Their 1 hour lunch break must be taken between 12 noon and 2 pm. The dark squares on the diagram below shows the hours they work.



(a) There should be at least 4 people in the shop at all times. Change the times that some of the workers work to plan this into the day.

(b) The manager of the shop wants to employ workers for 46 hours overall in the week. He will have to employ an additional worker. Add the additional worker to the plan. Remember they must have a 1 hour lunch break.

Extension

Additional scenarios can be posed that will need some adjustment to the plan.

For example:

– the manager might want to open the store at 9am but would prefer not to employ any additional staff. Show how he might adjust the hours worked to cover the early opening

– Belinda is a part time worker who has got another job elsewhere. Can her hours be given to other workers in the store? Can lunchtime hours still be covered?

This task involves planning. It could be either an individual or group task. Opportunities to develop PLTS skills of team work and reflective thinking are possible, and FS skills of analysis and interpreting. For some of the extension tasks, PLTS skills of creativity and of independent thinking could also be possible.

Presentation could involve listing the times that each of the workers spend in the shop.

Handling time is a general weakness in KS2 and KS3 students. This task will not only give opportunities for students to use time in a practical context, but any weaknesses will also be apparent for the teacher to use in planning future lessons.

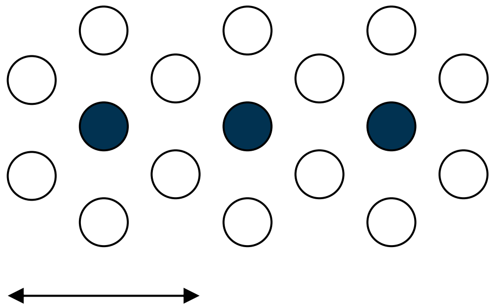
Problems and Patterns

Some problems have clear need for a particular technique in mathematics. If this is the case, then the teacher may need to ensure that some content is taught before students attempt the problem.

The following problem is linked to work on series, and could be extended to generalising algebraically. The teacher may therefore need to ensure that appropriate lessons are taught before the task is given out.

Problem 4

Consider a problem where a gardener wants to plan a path. The path is made from circular paving stones. There are two types of paving stones that are to be laid as shown.



2 metres

How many paving stones of each type will the gardener need to lay a path that is 16 metres long?

This type of problem can be differentiated: weaker students could be given counters to structure the problem, but the majority of students should be asked to develop a theoretical approach.

Extension

- Students could be asked to generalise: derive an algebraic formula for calculating the number of each type of paving stone given the length required.
- Given a cost for each paving stone (eg £2.50 for white, £3 for grey) calculate the total cost for a 16 metre path, or amend the generalisation to give the total cost.
- Change the context to consider more complex problems. For example, given a rectangular lawn of given dimensions plan a path to go around the perimeter of the lawn.
- Can this problem be generalised?

Most of the PLTS skills are accommodated within this task, particularly if team work is required. This is particularly the case if the task is widened to include research of local retail outlets, real life costing and budgets. FS skills are evident in analysis, and possible interpreting; representing also if students have to consider budgeting and presentation of their findings and/or conclusions.

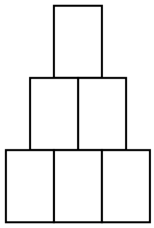
Problems from real life

Many problems that are functional will be derived from real life. This is not to say that all students will necessarily be prepared to deal with problems that arise in real life. Most of the problems that students will come across in the work environment cannot be replicated in the same way in the classroom. Besides the fact that the context is usually well understood by the problem solver, and methods of solution may be clear, maturity assists in bringing to the solution a better awareness of life, which school students do not normally possess.

In choosing a 'real life' problem to present to students the teacher must ensure that it is phrased in language that can be understood by the age group of the students. Further, these problems must not assume knowledge that might not be possessed.

The following problems might be considered appropriate for students preparing to move toward more complex functional skills problems.

Problem 5



In a supermarket a display is needed.

The display is to be made with cans.

Each can has a diameter of 6 cm and a height of 10 cm.

The width of the display needs to be no more than 2 metres wide.

How many cans will be needed to create a display of the maximum size?

This problem provides students an opportunity to consider a number of possible routes to the solution. It can be worked out practically, by scale diagram, by calculation and through generalisation. A similar situation arises with the next problem.

Problem 6

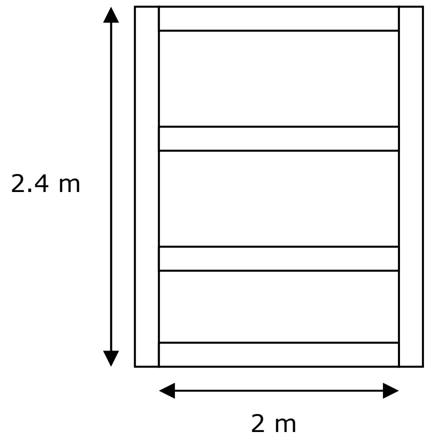
A display cabinet is being put together to hold boxes of cereal.

Each box of cereal has dimensions 36 cm by 12 cm by 6 cm.

The display cabinet has to have a height of 2.4 m, a width of 2 m and a depth of 30 cm.

It is made of wood.
The wood has a thickness of 3 cm.

What is the maximum number of boxes of cereal that can be stacked on a display cabinet?



This is a far more complex problem than the previous one since it relies on the student having some knowledge about how the cabinet will be put together using pieces of wood of a given thickness. There are many things to be taken into account like how many shelves you might need to fit in, which way around the boxes will be stacked, reconciling cm and m as measurements. It is a multi-step problem.

There is some obvious mathematical techniques that will need to be taught first, such as conversion of m to cm, perimeter, working with decimals, but the majority of the skills should come from earlier practice at problem-solving. This is not the type of problem to give to students as their first experience of functional type questions, but one that might be considered as students move from KS3 into KS4.

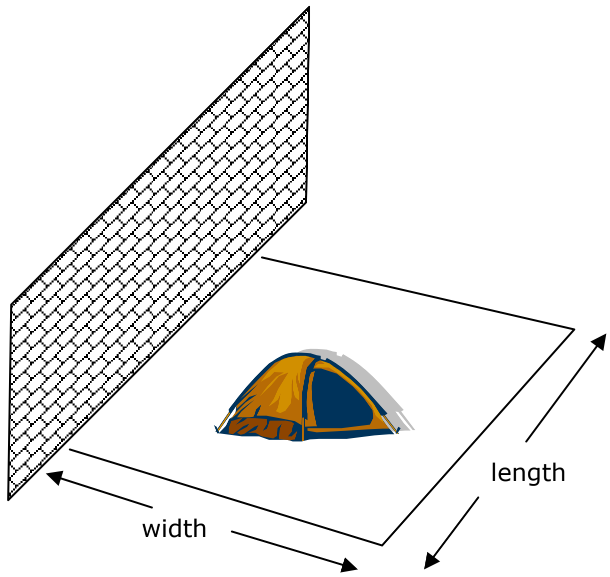
One might also describe this as a problem that could better be related to the world of work, a 'real life' problem. It could be extended further where students are asked to find how the wood should be bought, and the cost of building the display.

These tasks require more creativity in making decisions and choices. They are well placed to deliver opportunities for most of the PLTA and Functional Skills.

Extended tasks

Once students have gained practice at problems that are functional in nature, and have a basic understanding of what skills are required in solving such tasks, students can then be moved on to more extended tasks. Whether students are right for such tasks is a matter for the teacher to decide. These tasks could be completed during normal lesson time, or could be completed as part of a portfolio of tasks to that make up an activity session which lasts more than the normal lesson time.

Problem 7



A tent is to be put near to a wall.

A rectangular piece of land next to the wall is to be marked out using a piece of rope 50 metres in length.

(a) Write down some possible widths and lengths using the 50 m length of rope.

(b) What width and length will maximise the area of land for the tent?

This problem can be solved in several different ways. Having a choice of methods of solution is an important aspect of functionality. Students should be encouraged to work out their own process of solution, but could then investigate different solution processes of others, making comparisons with their own.

Methods could be graphical, or tabular with the use of a spreadsheet, and could also include trial or improvement.

Students could work in groups on the problem, each group reporting their method and processes for other groups to consider.

This problem offers possibility of embedding all PLTS and FS skills, particularly if group work is involved.

Interpretation and communication

Some problems require students to make sense of data, and to make some interpretation of the data. The next problem presents some information for the student to summarise and then interpret. KS3 students will be familiar with collecting data, but are less familiar with interpreting it. Many students find explaining and interpreting quite difficult. In particular students who have learning difficulties, and so may require additional assistance to begin with, when tackling such tasks. However, in GCSE examinations they will need to express themselves without such assistance. Separate marks will be awarded for the quality of such explanations, as is explained in the previous section.

Problem 8

Tourists returning home have been asked to rate their holiday. On a questionnaire they are asked to give a number for how good they think their holiday has been.

1 =very poor **2** =poor **3** = satisfactory **4** = good **5** =very good

These are the ratings for three different holiday resorts.

Resort A	4 3 5 3 3 4 2 3 4 3 3 4 2 3 4 1 4 3 4 2 3 2 3 4 5 4 3 4 4 4 4 3 3 1 4 4 3 5 3 4
Resort B	4 4 3 5 2 4 1 4 2 5 4 3 5 4 2 4 2 1 5 4 3 3 2 4 4 1 3 5 4 3 2 4
Resort C	4 4 5 4 2 3 2 4 5 4 5 4 5 4 3 4 1 5 4 5 3 5 4 3

Having been presented with the information the students could be asked questions.

Easier questions could be focussed, but harder questions could be more general.

(a) Which resort attracted more '5' votes?

(b) Which resort attracted a greater proportion of '4' votes?

(c) Overall which resort was the best?

These questions rely on increasingly sophisticated mathematical and functional skills.

For (a) all that would be required is a simple tally.

For (b) one might want to calculate proportion, perhaps in terms of percentages, which would reveal that C is best.

For (c) students might need to be placed in groups to debate the criteria they will want to use to make their assessment. A more sophisticated method would be to work out an average score.

The essential issue with part (c) is that it is open-ended enough that students have to make some choices themselves about how they are going to analyse the data. Once they have performed some mathematics the results then need interpreting; a complete answer will also have some text explaining the significance of the results, and drawing together a final conclusion.

This task offers opportunities for students to show creativity, to reflect on the mathematics that they have learned, and for open-ended parts such as (c) show some independence in their enquiries, all key PLTS skills. This task is strong in terms of assessing all three elements of functionality.

Presentation and Communication

An important aspect of interpretation is choosing language and forms of presentation to communicate the results. This includes choosing appropriate techniques such as graphs and tables to display information so as to communicate interpretation in a meaningful way.

The techniques of drawing various graphs, and also interpreting them, are taught at KS3, functionality comes through the decision making process of choosing the most appropriate graph, drawing it without structure, and interpreting the results. The final problem in this section presents an opportunity for students to demonstrate their ability to undertake such a task.

Problem 9

Maralyn has two toy shops. The sales figures for these two shops, over an 8 week period, are shown below.

Week	1	2	3	4	5	6	7	8
Kids' Dream	312	615	870	890	913	810	731	680
Toy Tales	540	730	815	942	910	739	860	874

Present these figures on an appropriate diagram and make some comments about the sales from the two shops.

These figures could be presented as a line graph, using two different lines for the two stores. Equally they could be presented as a dual bar graph. Comment could compare the different trends (up and down) and perhaps suggest in which months the maximum has been achieved, or compare the sale performance across particular months for the two stores. Though the actual comments need to be accurate, it is the ability of the students to make comparisons that is the skill that needs encouraging.

If working alone on this task PLTS skills include making independent enquiry, becoming a reflective learner, and creative thinking. Functional skills include aspects of representing, but are mainly associated with interpreting skills.

Conclusion

This part of the document describes how Functional Skills can be introduced into Key Stage 3 work in mathematics, in preparation for work at GCSE. The problems given are examples only; the challenge for teachers is to provide a much greater range of problems for students, and to give the guidance necessary that students will have acquired the PLTS and Functional skills necessary to enable them to approach such problems positively and confidently.

Section 2: Overview of new areas of testing at GCSE

There are three new areas of testing in the specification as required by QCDA.

1 Functional Elements

These are questions which could reasonably be considered to be real-life calculations in situations readily understandable by the average 16 year old. Whilst having a connection with functional skills, these differ by being individual self contained questions which can relate to any part of the specification.

30-40% of marks at Foundation tier.

20-30% of marks at Higher tier.

2 New Assessment Objectives

There are three of these.

AO1	Recall and use their knowledge of the prescribed content	45-55%
AO2	Select and apply mathematical methods in a range of contexts	25-35%
AO3	Interpret and analyse problems and generate strategies to solve them	15-25%

These questions may also be functional.

These new assessment objectives are explained in Section 5.

3 Quality of Written Communication (QWC)

Quality of written communication accounts for approximately 5% of the total marks, and is usually assessed on questions with 3 marks or more. On the live exam papers these questions will be marked with an asterisk.

The three strands of QWC, which are standardised across all subjects are outlined below:

(i) write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear

(ii) select and use a form and style of writing appropriate to purpose and to complex subject matter

(iii) organise relevant information clearly and coherently, using specialist vocabulary when appropriate.

The construction of a reasoned argument is also an aspect of QWC.

More details of how we intend assessing quality of written communication in mathematics can be found in Section 6.

Section 3: Functional elements and exemplar questions for GCSE

1 What are functional elements in GCSE Mathematics?

Edexcel GCSE specifications refer to functional elements rather than functional skills because their coverage is greater than that of the functional skills coverage (see *Appendix 1*). The emphasis in both is on the demonstration of process skills in realistic contexts, but in contexts that must be appropriate to 15/16 year olds (and older). Such examples would be timetables, scale drawings, cost comparisons, summaries and representations of data, wages and expenses. At Higher tier this could include proportionality, masses and volumes of similar shapes, trigonometry and calculations of surface areas.

The process skills are:

- representing a problem
- analysing the problem
- interpreting a solution to the problem (see *Appendix 2*).

These are assessed on the Edexcel Functional Skills papers and on Edexcel's new GCSE mathematics examination papers, with Units 1 and 2 for Specification B being tested for the first time from November 2010.

2 How many marks will there be on functional elements in the exam?

The Foundation tier papers/units will be written so that 30%-40% of the marks can be identified as addressing functional elements. There will be 20%-30% of the marks addressing Functional Elements at Higher tier.

The tables below show the range of marks that will have functionality for each of the papers/units.

Specification A

Paper	Total number of marks	Number of marks assessing Functional Elements
Foundation Paper 1	100	30-40
Foundation Paper 2	100	30-40
Higher Paper 1	100	20-30
Higher Paper 2	100	20-30

Specification B

Unit	Total number of marks	Number of marks assessing Functional Elements
Foundation Unit 1	60	18-24
Foundation Unit 2	60	18-24
Foundation Unit 3	80	24-32
Higher Unit 1	60	12-18
Higher Unit 2	60	12-18
Higher Unit 3	80	16-24

3 What will questions be like?

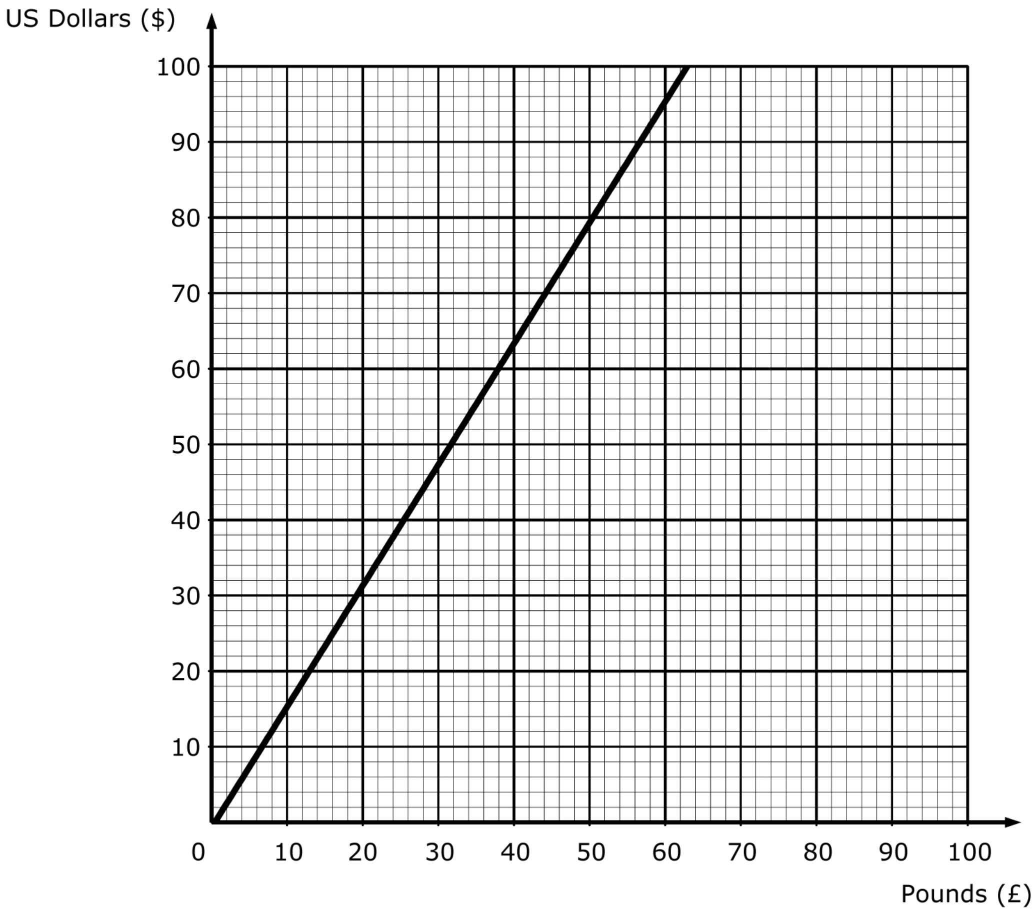
In general, questions will be set in a context which will be familiar to 15/16 year old students and will have at least 3 marks or more attached to them (see *Appendix 3*).

In papers where a calculator is allowed, the complexity of calculations will be appropriate and in context. On a non-calculator paper, skills such as scale drawing and estimation will be assessed in context.

4 How will questions be marked?

In contrast to the Functional Skills papers the functional elements will be marked according to the standard (revised) Edexcel GCSE mathematics mark schemes – with M, A, B and C marks. C or communication marks are awarded when the candidate has supported a conclusion with justification (either by clear calculation or diagram, or given supportive reasons).

Exemplar question 1 (Foundation)



The graph can be used to convert between pounds (£) and US Dollars ($).

(a) Use the graph to convert £40 to US Dollars.

(b) Use the graph to convert $86 to pounds (£).

Jim has to visit the USA where he will spend US dollars and then travel on to Jamaica where he will spend Jamaican dollars.

He plans to take £800 and change it all to US dollars. He expects to spend $500 in the USA and then change the rest into Jamaican dollars.

He thinks he will need at least 6000 Jamaican dollars to spend.

1 US dollar = 90 Jamaican dollars.

(c) Will he have enough Jamaican dollars?

The first two parts are standard technique. For part (c) the candidate has to reach a decision based on the use of the conversion graph and additional calculations.

Typically the marks would be:

Working	Answer	Mark	Additional Guidance
£50 = $80 £750 = $1200 $1200 – $500 = $700 700 × 90 = 6300	Yes with reasons	3	M1 for a correct method to convert £ to US $ M1 for ('1200 – 500') × 90 C1 for conclusion based on correct calculations

The process skills required in this question are:

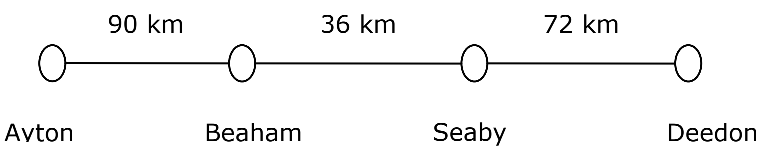
- *identify the situation or problem and the mathematical methods needed to tackle it*

  Understand what currency conversion is
- *select and apply a range of mathematics to find solutions*

  How to use the conversion graph for an application that cannot be read directly. Be able to convert currency by calculation
- *draw conclusions and provide mathematical justifications*

  Relate the final answer to the problem and answer 'yes' or 'no' according to whether it is more than 6000.

Exemplar question 2 (Higher)



The diagram represents 4 stations on a railway line.

A train travels from Ayton to Deedon stopping at Beaham and Seaby for 2 minutes at each station.

The train has an average speed of 90 kph between each station.

The train departs from Ayton at 09:00

Draw up a timetable for the 09:00 train.

Working		Answer	Mark	Additional Guidance
Station	**Time**	Correct TT	3	C1 Clear indication of stations and times in a table oe B1 Inclusion of Arrive and Depart with a gap of 2 minutes B1 Fully correct
Ayton	9:00			
Beaham (Arrive)	10:00			
Beaham (Depart)	10:02			
Seaby (Arrive)	10:26			
Seaby (Depart)	10:28			
Deedon (Arrive)	11:16			

- *Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations.*

  Understand that the diagram refers to a train line and that to model the journey it is necessary to use the average speed of the train.

- *Identify the situation or problem and the mathematical methods needed to tackle it.*

  Use of speed, distance and time to calculate times.

- *Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations.*

  Production of answers in a timetable form.

  (*See* Appendix 3 *for references to further questions*).

5 What are the similarities and differences between the Edexcel Functional Skills paper and the functional elements in the Edexcel GCSE mathematics papers?

The main differences are illustrated in the table below:

Edexcel Functional Skills	Edexcel GCSE Mathematics
3 tasks with an average of 16 marks split into parts which follow a theme.	Questions are self contained
Calculator allowed	Calculator allowed on some papers
Mathematical content restricted to those from national curriculum levels 1-6 shown in *Appendix 1*	Any mathematical content from national curriculum levels 1-6
Mathematical content cannot be above national curriculum level 6	Mathematical content can be above national curriculum level 6

6 What resources are available?

- Edexcel Functional Skills past papers
  http://www.edexcel.com/quals/func-skills/maths/Pages/Documents.aspx
- Edexcel Sample Assessment Materials and mock papers for Specification A and B
  www.edexcelmaths.com
- Ideas developed and shared by classroom practitioners
  http://www.tes.co.uk/searchResults.aspx?area=resources&keywords=functional%20maths
- Resources developed by the Government for the Functional Skills pilot (modified in 2009)
  http://www.excellencegateway.org.uk/pdf/T%20&%20L%20Maths%20Apr%202009.pdf
- Our published resources contain everything you need to master the functional elements of mathematics in GCSE, with dedicated pages and functional questions throughout. Visit www.pearsonschools.co.uk/tryedexcelgcsemathematics to find out more and download free sample material. For resources published for the Functional Mathematics qualification at levels 1 and 2 visit www.pearsonschools.co.uk/edexcelfsmathematics

We are also working with other publishers seeking Edexcel endorsement of their resources.

Section 4: Further examples of questions addressing functional elements at GCSE

In this section you will find examples of questions and answers that address the functional elements at GCSE. Please be aware that these are intended for classroom use, and therefore the layout and language used will not be of the usual examination style.

Questions

You may need the following imperial/metric conversions for some of the questions.

5 miles = 8 kilometres
2.2 pounds = 1 kg
1 gallon = 4.5 litres
1 foot = 30 cm

1 A bus can carry up to 96 passengers. It is also registered to take two wheelchair users and each of these counts as 4 passengers.

The bus leaves the station with 69 passengers. At its first stop it picks up two wheelchair users and 5 passengers. No-one gets off. At the next stop, 27 passengers get off and 9 get on. How many more passengers can the bus carry?

2 Turkeys can be slow or fast roasted.

Cooking instructions are:

Fast roasting	Allow 15 minutes + 30 minutes for each kilogram up to 6 kg. For weights over 6 kg allow 24 minutes for each extra kilogram.
Slow roasting	Allow 25 minutes + 50 minutes for each kilogram up to 6 kg For weights over 6 kg allow 45 minutes for each extra kilogram.

Adele has a 16 kg turkey to cook. She needs the turkey to be cooked for 7 pm.

What time should cooking start? Work out her options.

3 Mrs Dolan wants to buy a washing machine which has a cash price of £380.

The shop has two credit plans for the purchase of this washing machine.

Credit Plan A	**Credit Plan B**
A deposit of £135	A deposit of 15% of £380
plus	plus
6 equal payments of £47.50	12 equal payments of 8% of £380

Decide which credit plan to advise Mrs Dolan to use.

You must use calculations to support your advice.

4 Part of Martin's electricity bill is shown below.

Bill breakdown

Electricity used this period

Meter number 12345 **General purpose rate**

Reading period 24 September 2009 to 31st December 2009

	previous	latest	units used	unit split	pence	charges
Electricity used	77254	78361	....	first 240	at 17.86p	....
				ext ,,,,,,,,,,	at 10.89p	....

Total before VAT	....
Electricity Bill Saver discount	£2.00
Electricity charges	....
V.A.T. at 5%	....
Total charges for this period	**...........**

Complete Martin's bill.

5 Eunice has an old recipe for making flap jacks.

Ingredients to make **75** flap jacks

1 lb butter

$\frac{1}{4}$ lb brown sugar

15 level tablespoons of golden syrup

2 lb rolled oats

She wants to make **50** flap jacks and her scales measure in grams.

Work out the quantities of each ingredient that she should use.

6 Class 4 National Insurance Contributions for self employed people is 8% on profits over £6000

Income tax rates are 20% on profits over £6000 and up to £35200

Income tax for any profits over £35200 are at 40%

Ian is self employed.

Work out Ian's total tax bill for profit of £73000 for the year.

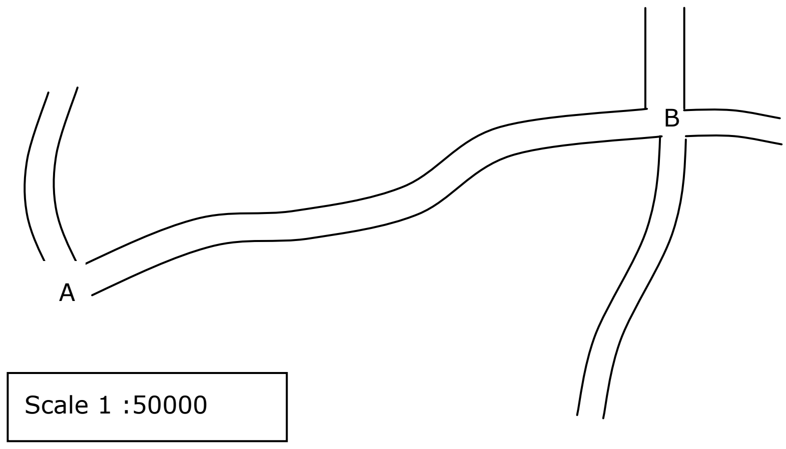
7 A 3 year income bond offers has two options.

One option is to take interest of 12.5% at the end of the three years.

The other option is to take 4% interest at the end of each year. In this option the interest can be added each year to the sum invested.

Compare the two options.

8



The diagram above shows a section of a map drawn to a scale of 1:50 000

Peter knows that for this kind of distance he will average about 16 km/h on his bicycle.

Estimate how long it will take Peter to cycle from A to B.

9 The fuel gauge on Mary's car registers $\frac{1}{2}$ full. At the same time her mileage meter shows 15 271 miles. She puts in 16 litres of fuel.

By the time the fuel gauge is back to $\frac{1}{2}$ full the mileage meter is up to 15 369

She uses this information to calculate the miles per litre for her car.

The petrol she uses costs 110.6p per litre.

She needs to travel from her home in South London to Eastbourne and back.

The cheapest rail ticket is £22 for the return journey.

The distance by road is 56 miles each way.

How does the cost by car compare with the cost by rail?

10 William is going to collect water from the roof of his shed which measures 8 feet by 10 feet. The DIY store has two sizes of water butt available. The larger holds 50 gallons and the smaller holds 25 gallons.

It is quite common for 2 cm of water to fall during a rain storm.

What size should he get?

You must show calculations to support your answer.

11 Adam is going to tile a splashback on the wall behind a bath.

The splashback will measure 210 cm by 90 cm.

His DIY store has two sizes of tiles.

10 cm square in packs of 25 and 15 cm square in packs of 44

Prices are 10cm square white £3.99 or colour £4.99 Single tiles 50p.

15 cm square white £8.99 or colour £9.99 Single tiles £1

He plans to use white to coloured tiles in the ratio of 5:2

What are the choices?

12 A ship is sailing on a bearing of 293° and the captain is aware of rocks indicated by a lighthouse 10 nautical miles away on a bearing of 291°. He must keep at least 650 metres from the lighthouse.

He decides to alter course to 294°.

(i) Did he need to alter course?

(ii) If the ship is travelling at 18 knots, how long will it be before the ship is nearest the lighthouse?

[1 nautical mile = 1.85 km, 1 knot = 1 nautical mile per hour].

Answers

1 First stop Passenger count
= 69 + 8 + 5 = 82

Second stop Passenger count
= 82 – 27 + 9 = 64

Number of extra passengers = 32

2 Fast roasting
15 + 30 × 6 + (16 – 6) × 24 = 435 min
435 min = 7 hr 15 min so start at 11:45

Slow roasting
25 + 50 × 6 + (16 – 6) × 45 = 775 min
775 min = 12 hr 55 min so start at 6:05

3 Plan A 135 + 6 × 47.50 = £420
Plan B 57 + 12 × 0.08 × 380 = £421.80

Plan B is slightly dearer but the payments can be spread across 12 months instead of 6 months

4 Units used = 78361 – 77254 = 1107

Costs:
First 240
240 × 17.86 ÷ 100 = £42.864

Next 867
867 × 10.89 ÷ 100 = £94.416

Total	=	£137.28
Electricity charges	=	£135.28
VAT at 5%	=	£6.76
Total charges		£142.04

5 Convert the units
455 g butter
114 g brown sugar
15 level table spoons of golden syrup
910 g rolled oats

Work out the new amounts
455g ÷ 75 × 50 = 303 g butter
114g ÷ 75 × 50 = 76 g brown sugar

15 ÷ 75 × 50 = 10 level tablespoons of golden syrup

910 ÷ 75 × 50 = 607 g rolled oats

6 Income tax at 20%
= (73000 – 6000) × 0.20 = £13400

Income tax at 40%
=(73000 – 35200) × 0.20 = £7560

Class 4 NIC
= (73000 – 6000) × 0.08 = £5360

Total = £26320

7 Option 1 Multiplier is 1.125

Option 2 Multiplier is 1.04^3 = 1.124864
so slightly less

8 Distance on map is 8 cm.

Real distance AB is 8 × 50000
= 400000 cm
= 4 km.

Time is 15 minutes.

9 Rate of fuel consumption is (15369 – 15271) ÷ 16
= 6.125 miles per litre

Petrol used for the journey
= 112 ÷ 6.125 = 18.29 litres

Cost of petrol
= 18.29 × £1.106 = £20.22

10 Area of roof
= 8 × 30 × 10 × 30 = 72000 cm^2

Amount of water
= 72000 × 2 = 144000 cm^3 = 144 litres

Convert to gallons 144 litres
= 144 ÷ 4.5 = 32 gallons

The 50 gallon butt is preferable

11 10 cm tiles. Number of tiles =

$\frac{210}{10} \times \frac{90}{10}$ = 189

This requires $189 \times \frac{5}{7}$ = 135 white and 42 coloured tiles

135 White is cheapest when 6 packs are bought at a cost of £23.94

42 coloured is cheapest when 2 packs are bought at a cost of £9.98

Total cost = £33.92

25cm tiles. Number of tiles = $\frac{210}{10} \times \frac{90}{10}$ = 84

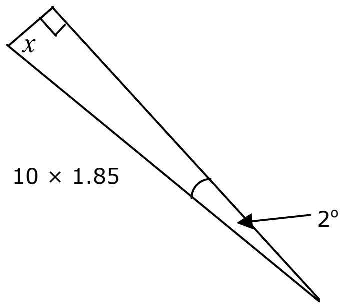
This requires 60 white and 24 coloured

60 white is cheapest when 2 packs are bought at a cost of £17.98

24 coloured is cheapest when 1 pack is bought at a cost of £9.99

Total cost = £27.97

12



x = 18.5 x sin2°
x = 0.6454 km so does need to change.

New distance to closest approach

= 18.47 km

Time is 18.47 ÷ (18 × 1.85) = 0.555 hr
= 33 minutes.

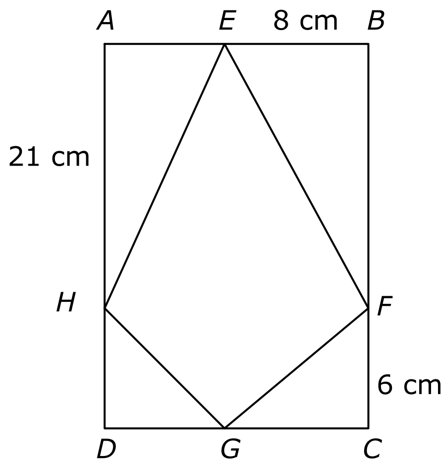
Section 5: The assessment objectives and exemplar questions

AO1 **is testing of knowledge of techniques and not exemplified here.**

AO2 **is where more than one approach is possible and the candidate has to select a suitable method to use.**

AO3 **is where a there is a problem to be solved. This involves devising a strategy to deliver a solution. The problem may be a problem only by virtue of being an unfamiliar setting and solved by a routine technique.**

1 In the diagram, *ABCD* is a rectangle containing a kite *EFGH*.

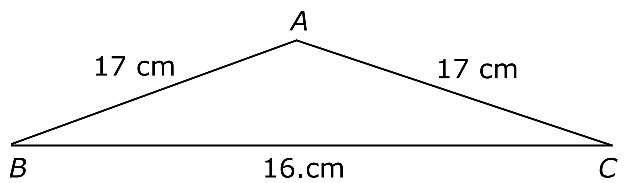


Find the area and perimeter of the kite.

This is AO3 problem solving. Missing lengths can be deduced and Pythagoras applied. This gets the perimeter. The area is best obtained by subtracting the area of the four triangle from the area of ABCD.

Although targeting grade C topics, the nature of the problem makes it more moving towards grade B.

2



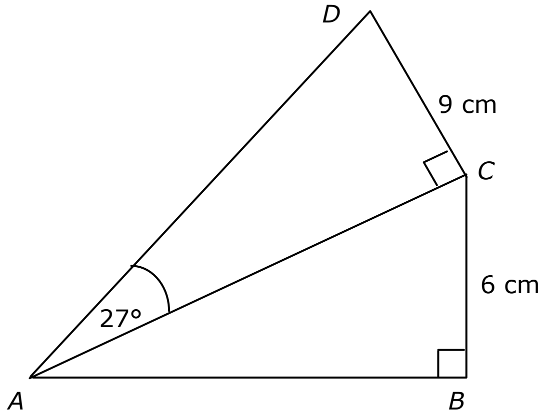
Find the area of triangle *ABC*.

This can be done by using the cosine rule to find angle ABC followed by $\frac{1}{2}$*absinC.*

Alternatively, it can be done more neatly using Pythagoras' theorem after drawing in the perpendicular from A. Then half base x height.

This is thus AO2. Targeting grade A/B.

3 Angles *ACD* and *ABC* are right angles.



Find AD or find angle ADC.

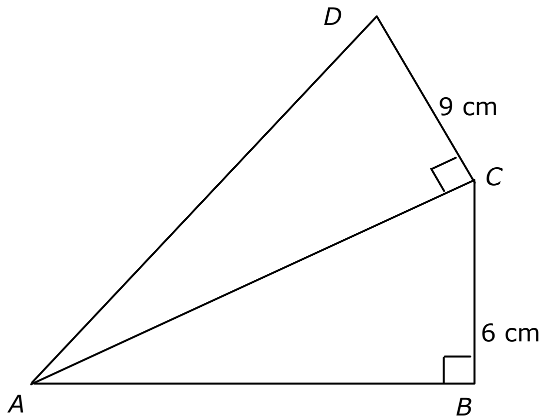
The two step solution involves finding AC followed by the answer.

Other methods via AB and Pythagoras' theorem are inefficient, requiring an additional step.

Hence this is AO3, targeting grade B.

4 Angles *ABC* and *ACD* are right angles.

Triangles *ABC* and *ACD* are similar.



Find the length of *AB*.

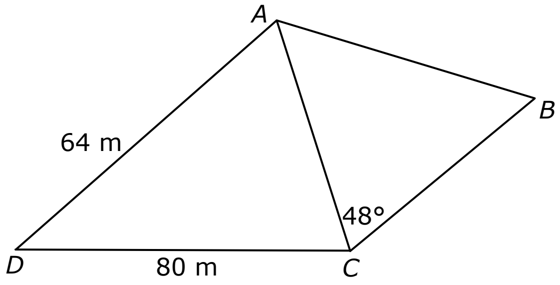
This is a tricky problem solving situation (AO3).

Obtain AC and AD by Pythagoras' theorem.

Then AD = 1.5 x AC to find AB = 2.4√5.

Targeting Grade A.*

5 In the diagram, $AB = AC$.



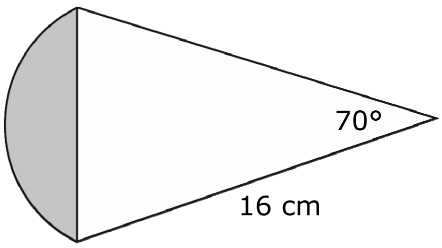
Find the length BC Triangles ADC has an area 120 m^2

Start by finding angle D. Then cosine rule to find AC and hence AB.

Sine rule allows BC to be obtained.

This is AO3, targeting grade A.*

6



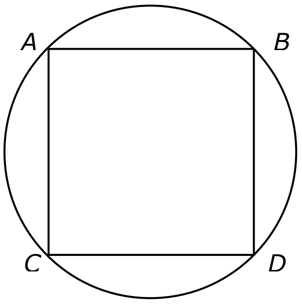
Find the shaded area.

You need to find the radius of the circle from 8 ÷ cos 70°.

The sector is $\frac{1}{9}$ of the circle, so segment area = $\frac{1}{9}$ πr^2 – area of triangle.

This is AO2, targeting grade A.

7 *ABCD* is a square inscribed inside a circle of radius 15 cm.

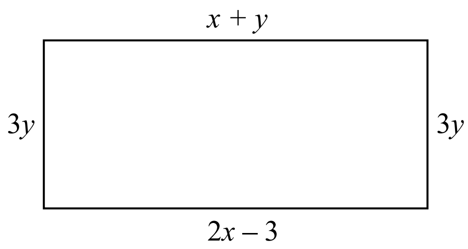


Find the area of the shaded segment.

Straightforward AO2, targeting grade B.

8 The diagram shows a rectangle. All the measurements are in centimetres.

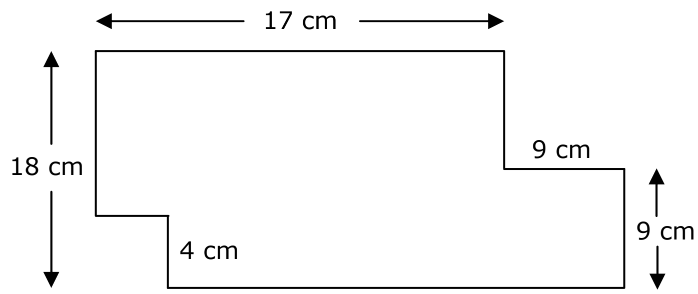
The area of the rectangle = 30 cm² and its perimeter = 52 cm.



Find the dimensions of the rectangle.

AO2, targeting grade C.

9 The diagram shows a rectangle with two squares removed.



Find the area of the shape.

AO2, targeting grade D.

10 A bus has 62 seats.

There are 28 people on the bus when it stops and 13 people get on and 8 get off.

At its next stop, 2 people get on and 9 get off.

How many seats are now unoccupied?

This is AO2 as there are several ways of doing this. Targeting grade F/G.

11 A flat steel plate measures 2 m by 35 cm.

Its mass is 6 kg and the density of the steel is 8.3 g/cm^3.

Work out the thickness of the steel plate.

Give your answer in millimetres.

There are several decisions to be made so this can be argued as AO2 or AO3.

12 A standard cup holds 250 ml.

It takes a dripping tap $4\frac{1}{2}$ minutes to fill the cup.

How long will it be before 1m^3 of water has dripped from this tap?

Give your answer in hours.

This is AO2, targeting grade E. The only real problem is converting m^3 to cm^3 and hence ml.

Section 6: Quality of Written Communication (QWC)

Spelling, punctuation and grammar are not necessarily relevant when answering mathematics questions, the assessment of 'quality of written communication' has to be tailored to the subject. Questions will NOT be written to specifically address this requirement but will occur quite naturally within the context of traditional questions. Hence, QWC marks are extended to include:

- the construction of a reasoned argument such as would be seen in a proof. They will also be seen when work needs to be presented in an ordered way which allows the examiner to follow the work without difficulty
- well presented statistical diagrams with clear labelling, scales and/or axes
- work where evidence has to be gathered with a clearly stated decision or outcome.

Examples can be found in the Sample Assessment Materials.

In particular, from Specification B – Modular (2MB01).

Unit 1

5MB1/1F Q5, Q7, Q9, Q11

5MB1/1H Q2, Q3, Q9, Q14

Unit 2

5MB2/2F Q10, Q12, Q15

5MB2/2H Q5, Q11

Unit 3

5MB3/3F Q4, Q13, Q14

5MB3/3H Q5, Q15, Q16

Appendices

Appendix 1	37
Appendix 2	39
Appendix 3	41

Appendix 1

Functional skills standards: mathematics level 1

Standards	Coverage and range
	Content and skills are equivalent to national curriculum mathematics levels 1–4, the adult numeracy standards and the application of number key skill, level 1.
Learners can: • 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.	• understand and use whole numbers and recognise negative numbers in practical contexts • add, subtract, multiply and divide whole numbers using a range of mental methods • multiply and divide whole numbers by 10 and 100 using mental arithmetic • understand and use equivalences between common fractions, decimals and percentages • add and subtract decimals up to two decimal places • solve simple problems involving ratio, where one number is a multiple of the other • use simple formulae expressed in words for one- or two-step operations • solve problems requiring calculation, with common measures including money, time, length, weight, capacity and temperature • convert units of measure in the same system • work out areas, perimeters and volumes in practical situations • construct models and draw shapes, measuring and drawing • angles and identifying line symmetry • extract and interpret information from tables, diagrams, charts and graphs • collect and record discrete data and organise and represent information in different ways • find mean and range • use probability to show that some events are more likely to occur than others • understand outcomes, check calculations and explain results.

Functional skills standards: mathematics level 2

<table>
<tr><th>Standards</th><th>Coverage and range</th></tr>
<tr><td></td><td>Content and skills are equivalent to national curriculum mathematics levels 1–6, the adult numeracy standards and application of number key skill, level 2.</td></tr>
<tr><td>Learners can:
• understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations
• identify the situation or problem and the mathematical methods needed to tackle it
• select and apply a range of mathematics to find solutions
• use appropriate checking procedures and evaluate their effectiveness at each stage
• interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations
• draw conclusions and provide mathematical justifications.</td><td>Learners can:
• understand and use positive and negative numbers of any size in practical contexts
• carry out calculations with numbers of any size in practical contexts
• understand, use and calculate ratio and proportion, including problems involving scale
• understand and use equivalences between fractions, decimals and percentages
• add and subtract fractions; add, subtract, multiply and divide decimals to a given number of decimal places
• understand and use simple equations and simple formulae involving one- or two-step operations
• recognise and use 2D representations of 3D objects
• find area, perimeter and volume of common shapes
• use, convert and calculate using metric and, where appropriate, imperial measures
• collect and represent discrete and continuous data, using ICT where appropriate
• use and interpret statistical measures, tables and diagrams, for discrete and continuous data, using ICT where appropriate
• use statistical methods to investigate situations
• use a numerical scale from 0 to 1 to express and compare probabilities.</td></tr>
</table>

Appendix 2

Functional skills standards: Process skills

Representing	Analysing	Interpreting
Making sense of situations and representing them	**Processing and using the mathematics**	**Interpreting and communicating the results of the analysis**
A learner can: • recognise that a situation has aspects that can be represented using mathematics • make an initial model of a situation using suitable forms of representation • decide on the methods, operations and tools, including ICT, to use in a situation • select the mathematical information to use.	A learner can: • use appropriate mathematical procedures • examine patterns and relationships • change values and assumptions or adjust relationships to see the effects on answers in the model • find results and solutions.	A learner can: • interpret results and solutions • draw conclusions in the light of the situation • consider the appropriateness and accuracy of the results and conclusions • choose appropriate language and forms of presentation to communicate results and conclusions.

Source: QCDA 2007

Appendix 3

Distribution of marks on questions assigned to assessing functional elements on the Sample Assessment Materials.

Specification A

Paper 1	F 5 6 8 2 3 4 3 3 6
Paper 2	F 2 8 2 3 4 6 6 9
Paper 1	H 4 6 4 3 6
Paper 2	H 4 2 8 4 4

Specification B

Unit 1	F 5 6 5 4
Unit 2	F 2 7 3 5 6
Unit 3	F 4 5 6 5 6 5
Unit 1	H 6 4 6
Unit 2	H 6 6
Unit 3	H 3 5 2 4 3

Acknowledgements

This document has been produced by Edexcel 's mathematics experts, including both teachers and examiners. Edexcel would like to thank all those who contributed their time and expertise to its development.

Authorised by Graham Cumming
Prepared by Suha Yassin

Publications code UG023224

Publications Code UG023224 October 2010

For more information on Edexcel and BTEC qualifications please
visit our website: www.edexcel.com

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH. VAT Reg No 780 0898 07