ADVANCED (QCA LEVEL 3)
KEY SKILLS:

APPLICATION OF
NUMBER

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Introduction

The pack *Advanced (QCA Level 3) Key Skills: Application of Number* is part of the Chalkface response to the increasing demand for key skills at Advanced Level for both GNVQ and A level courses. All worksheets are cross-referenced to the September 2000 Key Skills criteria at Level 3 as specified by QCA.

Student suitability The context for each task is intended to be non-subject specific to allow for maximum use across Advanced Level. The pack aims to equip students with the mathematical skills necessary for their vocational or A level study. The experience gained in this key skill area may then be used in student applications for higher education and employment.

Using the pack A cross-referenced grid, located on page 4, indicates the Key Skills criteria covered by each page. A full listing of these criteria can be found at the end of this pack.

Towards the end of the pack, you will also find glossaries of mathematical terms and techniques. These reference materials should be made available to students when carrying out certain activities in this pack.

The Teachers' Notes provided opposite each worksheet give the page's aims, preparation needed, classroom management advice, differentiation possibilities, answers and extension activities. We presume that you have access to pen, paper and chalkboard, and that students are used to working both individually and in small and large discussion groups. If you have a query about how best to use the pack, we are happy to help; please write to us at the address below.

Links There are two further packs in this series – *Advanced (QCA Level 3) Key Skills: Communication* and *Advanced (QCA Level 3) Key Skills: Information Technology*.

The people involved Sally Marshall, the consultant for this pack, is the Deputy Head teacher and Key Skills Co-ordinator at Coquet High School, Northumberland. Dorothee Remmert, the writer of this pack, is a part-time teacher and tutor. The pack was illustrated by Chris Goldhawk and the cover and series design was by Michael Lopategui. Tony Horsfall was the editorial co-ordinator and Karen Stock was the editor. The Chalkface format was created by Susan Quilliam.

Contents

Lesson-specific Teachers' Notes are to be found on the page facing each worksheet.

Application of Number Key Skills at Level 3

Page	N3.1	N3.2	N3.3	Checklist
7	✓			Planning an activity: deciding what data to collect, identifying possible sources of data.
9	✓	✓	(✓)	Choosing appropriate methods for obtaining results; calculating energy values.
11	✓	✓	✓	Planning an activity; carrying out a costing exercise; examining and justifying choice of methods.
13		✓	✓	Calculating averages and range using spreadsheets; presenting findings; interpreting results.
15	✓	✓	✓	Interpreting information; estimating; comparing estimation with calculations; interpreting results.
17		✓	✓	Carrying out calcuations; constructing appropriate charts to present information.
19	✓	✓		Reading and understanding ways of writing very large/small numbers; carrying out calcuations.
21	(✓)	✓		Carrying out calcuations using conventions for writing very large/small numbers.
23		✓	✓	Calculating and comparing ratios; constructing and labelling diagrams.
25		✓	✓	Working with cumulative frequency to find and interpret median and interquartile range.
27		✓	✓	Calculating percentages and proportional change; constructing and interpreting line graphs.
29	(✓)	✓	✓	Recognising the adverse effect of manipulation and distortion on the presentation of data.
33	(✓)			Planning a questionnaire; choosing appropriate methods for obtaining relevant results.
35	✓	✓	✓	Recognising and describing the main features of data involving exponential growth and decay.
39		✓		Working with grouped data and measures of central location.
43		✓		Calculating standard deviation.
45	✓		✓	Interpreting data and graphs (normal distribution); constructing and interpreting graphs.
47	✓			Choosing appropriate methods: selecting an appropriate sample; awareness of sample bias.
49	✓	(✓)		Estimating; random sampling; justifying choice of methods.
51	(✓)	✓	✓	Interpreting graphs; calculating mean, median, mode and interquartile range; presenting findings.
55	(✓)	✓	(✓)	Interpreting data; calculating correlation; interpreting results.
59	(✓)	(✓)	✓	Constructing and using scattergraphs and lines of best fit.
63	✓	✓	(✓)	Interpreting data; calculating mortality rates.
65		✓		Calculating the probability of independent events.
67		✓	✓	Calculating and interpeting moving averages.
69	✓	✓		Choosing and working with appropriate tolerances for measuring risks.
71		✓	(✓)	Using approximation and being aware of error accumulation.
73	✓	✓	✓	Interpreting graphs; producing an inequation; constructing graphs.

For full descriptions of Level 3 Key Skills evidence criteria, please see appendix, page 80.

General Guidelines

The Teachers' Notes opposite each page support the use of each specific page as required. These more general guidelines give advice on using the whole pack. They offer suggestions on preparation, running the lesson and follow-up work, and could form the basis of in-service training prior to using the pack.

Please remember to photocopy both the relevant Teachers' Notes, Glossaries and these General Guidelines if you are copying worksheets for a supply teacher to use.

Preparing for the lesson

- Specific preparation requirements are indicated in the *Preparation* section of the Teachers' Notes. You should always have available: copies of the worksheet; copies of the datasheet (where applicable); calculators; graph paper; pens; pencils, rulers and a chalkboard or equivalent.

- Allow approximately an hour's lesson for each page. If there may be too much or too little work for an hour, this is indicated in the *Timing* section of the Teachers' Notes.

- You can link pages to make a double lesson; linkable pages are indicated under the heading *Links*.

- Any issues of a sensitive nature, and possible classroom management challenges that may be created by the page are flagged in the Teachers' Notes under the heading *Points To Be Aware Of*. You will probably want to check whether these are relevant to your class.

The lesson

Pages are worded so that you can choose how to manage each in the classroom. However, as a general guideline, we suggest that you move from 'introductory chat' to individual work, through to paired or small group discussion, then to pooling ideas as a class. Where a specific approach is required which differs from this, it is indicated in the Teachers' Notes under the heading *Classroom Management*.

Each sheet contains a number of activities. These fall into several basic formats:

- **Thought starters**
- **Reading**
- **Oral work**
- **Brainstorming**
- **Research**
- **Working in role or 'imagine' exercises**
- **Written work**

Wherever possible, original data has been used, often collected by students themselves. However, in some cases, we have drawn on sources such as *Social Trends* or *Whittaker's Almanac*.

Following up on the lesson

The Teachers' Notes may include, where relevant, suggestions for *Extension Activities.* These are usually designed to carry the topic into a double lesson, or to provide an opportunity for out-of-classroom work.

Teachers' Notes

Aims The page introduces the need for gathering data and explores how this can be done. It also introduces the terms 'primary' and 'secondary' information.

Classroom Management Students could work in pairs or small groups.

Links Further sources of primary data are considered in FOOD FOR THOUGHT and QUESTIONNAIRE RESEARCH.

Answers *Activity 3:* Primary data is collected by taking measurements, carrying out an experiment or conducting a survey. Secondary data can be obtained from books, newspapers and magazines, CD-ROM, the Internet, television, radio etc.

Extension Activities Students could visit their school resource centre and/or local library to investigate what general sources of information are available to them. They could be asked to obtain specific data or they could set themselves a task. The students should be asked to look further than the first reference they find, and to quote the source of all secondary data. This list could include:
- directories
- encyclopedias
- CD-ROM – for example back copies of newspapers or publications such as *Social Trends, Regional Trends,* and *The Household Expenditure Survey*
- the Internet.

The *Guinness Book of Records* also provides an excellent source of data.

Key Skills N3.1

Students must show they can:
- Plan how to obtain and use the information required to meet the purpose of the activity.
- Obtain the relevant information.
- Choose appropriate methods for obtaining the results required and justify their choice.

Snowed Under!

Imagine you are planning a skiing trip with a few friends. What information would you need to find out? Give reasons for your choices. How would you obtain the information?

One of your friends claims to have devised three key questions that you should ask before tackling any problem:

- What do I already know?
- What do I need to know?
- Why do I need to know it?

Discuss these questions and check them against the project of organising a skiing trip. Are they sufficient? Which questions would you add, if any?
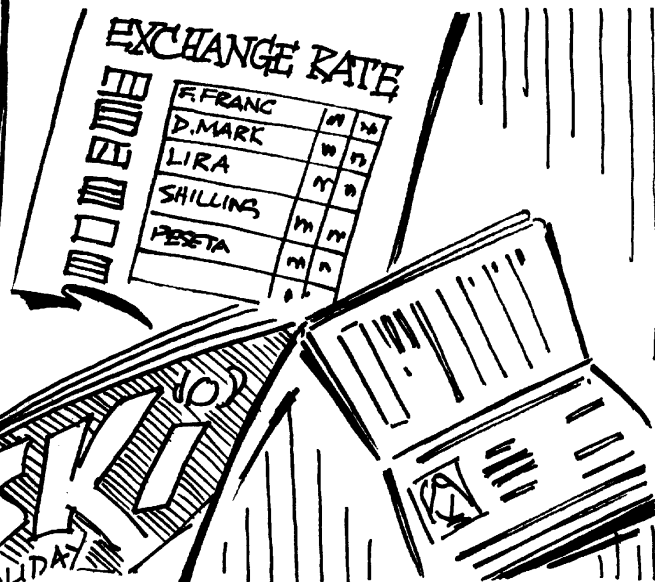
When planning any project, there are two sources of information available to you; **primary information,** which has been collected by yourself, and **secondary information,** which has been collected by someone else, usually better resourced than yourself.

Give examples of primary data you could obtain yourself. What means of collection do you have? Name as many as you can think of.

Discuss the relative merits of the two sources of data. Where could you obtain secondary data?

Food for Thought

Aims	This page shows how an experiment can be used to collect primary information.
Classroom Management	Although this page uses experimental data, it is not necessary to conduct the experiment itself.
Links	The terms 'primary' and 'secondary' information are introduced in SNOWED UNDER!
Answers	*Activity 1:* Suggestions for primary sources of information could include questionnaires, surveys, observations, and interviews. Possible sources of secondary information could include newspapers, magazines, health leaflets, directories, almanacs, CD-ROM, and the Internet. When discussing the relative value of secondary sources, students should appreciate distorting influences like: bias and sensationalism in the media; the interests of pressure groups; and advertising strategies.

Activity 2: The experimental data allows consumers to make informed decisions about the calorific/energy content of different foods when choosing a balanced diet. While the experimental design has inherent problems (such as the transfer of energy from the burning food sample to the atmosphere), it is adequate to indicate significant differences in energy value. Certain foods are not suitable for this experiment, for example chocolate would melt rather than burn.

Activity 3: The calculations are as follows:
$(0.54 - 0.40) = 0.14$g of peanuts raised the water temperature by $(30 - 21) = 9°C$.
0.14g of peanut contains $(9 \times 0.42) = 3.78$ kJ of energy
1 gram of peanut contains $^{3.78}/_{0.14} = 27.0$ kJ of energy

$(1.07 - 0.16) = 0.91$g of crisps raised the water temperature by $(28 - 19) = 9°C$.
0.91g of crisps contains $(9 \times 0.42) = 3.78$ kJ of energy
1 gram of crisps contains $^{3.78}/_{0.91} = 4.15$ kJ of energy

$(0.96 - 0.10) = 0.86$g of rice paper raised the water temperature by $(25 - 20) = 5°C$.
0.86g of rice paper contains $(5 \times 0.42) = 2.1$ kJ of energy
1 gram of rice paper contains $^{2.1}/_{0.86} = 2.44$ kJ of energy

Extension Activities	Students could design their own experiment (or a modified version of this experiment) that enables them to obtain accurate data. They need to be clear about the purpose of the experiment and the information to be obtained.
Key Skills	N3.1; N3.2; (N3.3)

Students must show they can:
- Choose appropriate methods for obtaining the results required and justify their choice.
- Carry out calculations to appropriate levels of accuracy, clearly showing their methods.

Food for Thought

Cherry is a student who is investigating eating habits in Year 10. Discuss what primary research methods Cherry could use. What data could she obtain from each method?

On the other hand, there are secondary sources at Cherry's disposal such as television programmes, books, and reference material such as 'Social Trends'. How valuable are these sources for Cherry's project? Can you suggest others?

One source of primary data is the scientific experiment. The following method describes an experiment designed to investigate the energy value of different foods:

1. Measure 100 cm³ of water into a flask then clamp the flask to a retort stand.

2. Record the temperature of the water.

3. Record the mass of a food sample.

4. Use a Bunsen burner to set the piece of food alight.

5. Move the burning food under the flask (so the heat from the food heats the water in the flask).

6. Retake the temperature of the water.

7. Record the mass of the remaining burned food.
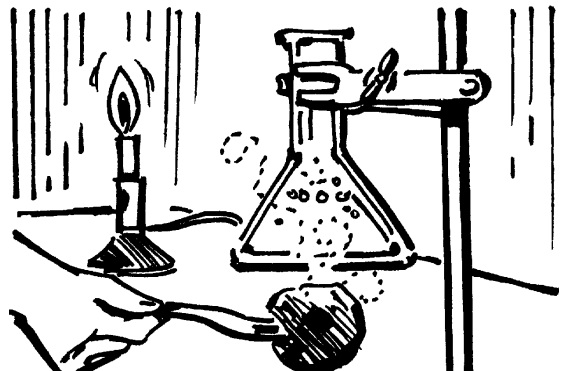
Why is it important to measure the energy values of food? How reliable are the results in your opinion? Which types of food would not be suitable for this experiment? Why?

The experiment was carried out using three types of food – and the results are shown opposite.

It takes 0.42 kilojoules (kJ) of energy to increase the temperature of 100 cm³ of water by 1°C.

Using the information given, can you calculate the energy value in 1 gram of each type of food?

Type of food	Initial mass of food g	Final mass of food g	Initial water temperature C	Final water temperature C
Peanuts	0.54	0.40	21	30
Crisps	1.07	0.16	19	28
Rice Paper	0.96	0.10	20	25

Aims The page encourages students to adopt a planned approach to problem-solving, and to devise suitable documentation to support their work.

Preparation In this activity, students measure their sixth form social area. Prior to the lesson, you will need to organise tape measures and access to the area. You will also need to provide (or ask the students to research) the price per width of various types of carpeting.

At the end of the lesson, and for future use, you might want to provide the students with a 'monitoring and evaluation' form. GNVQ students are very familiar with this concept, but A level students might need more guidance. Our suggestions for this form are:

1. Points at which monitoring has occurred – revision of plan as a result of monitoring.
2. Evaluation:
   Did you achieve your aim?
   Have all aspects of the problem been fully explored?
   Have you answered the question?
   Have you done what you set out to do?
   Have you missed out any important things that you should have considered?
3. Approach used – alternatives/improvements.

Classroom Management This page provides an excellent opportunity to demonstrate that application of number can help students tackle everyday tasks – it is not confined to mathematical exercises that are stripped of their context.

Extension Activities Students could extend their planning stages by including the monitoring and evaluation of the task. They should then pilot it against their next investigational task and refine their approach if they discover flaws.

Key Skills N3.1; N3.2; N3.3

Students must show they can:
- Choose appropriate methods for obtaining the results required and justify their choice.
- Carry out calculations to appropriate levels of accuracy, clearly showing their methods.
- Explain how the results of their calculations relate to the purpose of the activity.