Version 1.2 0208

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE Information and Communication Technology (Specification B)

Coursework Support Material

Exemplifying The Marking Scheme

Theme 2: Controlling, Measuring and Modelling Example 1

2008

Version 1.2 0208

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

Note:

The examples given in this booklet usually demonstrate the absolute minimum that is required for each mark. Any work showing less evidence than that shown is therefore likely to be awarded less marks.

Coursework – Controlling, Measuring and Modelling

The marking criteria are given in the syllabus, together with some explanatory notes. This section includes these criteria, together with additional guidance from the Syllabus Support Material and exemplar paragraphs for each criterion.

The notes are provided to amplify the application of the marking criteria. They are given for guidance and to aid supervisors in the assessment of coursework, not to replace the criteria themselves. If centres have specific enquiries in relation to the marking criteria, they are encouraged to contact AQA for further clarification.

The exemplar paragraphs indicate the minimum standard expected for the award of a particular mark. If a candidate's work does not exceed or meet the content shown for a given mark in these paragraphs then that mark cannot be awarded.

For some criteria, evidence in the form of print-outs, screen dumps or diagrams will be needed. These are indicated for each criterion, with suggestions as to the nature of this supporting evidence. For some criteria the report itself will provide the necessary evidence.

The number of marks is not related to the amount of text written to evidence any criterion. In these samples the examples for higher marks are often slightly longer: this is because they are intended to show the difference in evidence needed to support each criterion.

There is no virtue in encouraging candidates to illustrate each criterion many times.
Validation, for example, can be justified within a context by explaining how two or three cells are validated (using more than one technique): it is not necessary to explain in detail how all twenty cells are validated.

A - Description of the task to be attempted (3 marks)

3	The description is concise and clear and shows a good understanding of what is involved within the problem
2	Description is evident and shows some understanding of the problem
1	A simple outline of the problem to be solved
0	Little or no description

This task will focus on applications where information and communication technology is used to model real world situations, to investigate "what if?" problems and to measure and process physical data. The software that will be most relevant to this theme includes spreadsheets, other modelling and simulation software, expert systems and programming languages. The thrust of the task involves using ICT to solve a problem. The task should address identifiable needs, preferably of a third party, and provide scope for candidates to demonstrate breadth and depth in their use of ICT.

If a candidate chooses a task that is trivial, i.e. that no investigation or analysis is required and the candidate needs to make no choices, it will be hard to award marks for the description of a task. Few candidates are expected to select tasks that fall into this category. Teachers should approve the tasks that candidate chooses.

To be worth more than 1 mark, the description should provide sufficient detail to provide a clear indication of the problem, in both depth and extent that the candidate has chosen to solve. For 3 marks, the problem will require the candidate to explain clearly what the problem is and the extent of the difficulties being faced by the third party.

Evidence in report

The examples given below show how these marks could relate to tasks set within a specific context, that of a traffic management model.

1 mark minimum requirements - work showing less evidence can be worth no marks
Our class had to do a traffic survey to investigate the traffic flow from the A38 to the city centre along one route. Because this is a main route into the city it gets very busy in the morning and evening, with people travelling to and from work and the shops. We had to find out if the road carried more traffic than it should for its width, and then suggest ways in which the traffic or the road could be changed to make things better.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
Our class had to do a traffic survey to investigate the traffic flow from the A38 to the city centre along one route. Because this is a main route into the city it gets very busy in the morning and evening, with people travelling to and from work and the shops. We had to find out if the road carried more traffic than it should for its width, and then suggest ways in which the traffic or the road could be changed to make it meet government figures for traffic density. This meant quite a lot of calculations to investigate the effect of changing variables about the road like its width and the traffic flow. I have been asked to design a spreadsheet model by the local council traffic planner that can be used by him to calculate traffic density on a given stretch of road, allowing a number of variables to be investigated in a structured way.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
In order to determine whether a road is over-saturated, i.e. it carries more traffic than it was designed to, the local council need to carry out a traffic survey at different times of day measure physical characteristics of the road calculate road loading. If the road is over-saturated then the council needs to investigate ways of reducing the load. This could be by widening it, using park-and-ride schemes or banning commercial vehicles. My investigation is designed to replicate these activities and come up with a recommendation. I have been asked to design a spreadsheet model by the local council traffic planner that can be used by him to calculate traffic density at a number of linked locations, allowing a number of variables to be investigated in a structured way.

B - Analysis (3 marks)

3	A clear understanding and analysis of what is involved within the problem, an insight into the possible methods that could be employed in its solution and reasons for the chosen method of solution.
2	An understanding and analysis of what is involved within the problem and an insight into the possible methods that could be employed in its solution
1	Some analysis of what is involved within the problem
0	No, or a cursory, analysis

Here the candidate should have analysed the task and have looked at the possible alternative methods of solution. To gain 3 marks the candidate should make a reasoned judgement as to why the chosen method of solution is to be used.

The candidate must show some evidence in the report of the investigation and analysis, and marks are awarded in the light of this evidence. However, this investigation should be of the problem and not of the solution. This evidence may be a needs analysis carried out by questionnaire, examples of similar systems implemented in different contexts or some relevant information from sources such as business organisations, internet sites or printed resources. Note that weaker candidates may flood the report with large volumes of printouts and similar materials, without any indication of understanding of relevance (or otherwise) to the task. This type of evidence cannot be given a great deal of credit, and is unlikely to be worth more than 1 mark. For more than one mark there must be an examination of other methods of solving the problem

Evidence in report

1 mark minimum requirements - work showing less evidence can be worth no marks
I used the resources in the Geography department and found out that the government measures traffic density in Passenger Car Units (PCUs). Each type of vehicle has a different PCU value. The figures that I used were: Bicycles 0.5, Motorbikes 0.5, Cars 1 Vans and minibuses 2 Lorries and buses 3

The government have also produced numbers for different types of roads that tell us whether or not the road is too busy for its size. These sets of figures were on the same sheet and I've copied them in here. Road Type/Width Saturation value (PCUs per hour) Up to 7.3 m (2 lane road) 375 Up to 10m (3 lane road) 688 Up to l4m (dual carriageway) 1512 Motorway 3024

2 mark minimum requirements - work showing less evidence may be worth 1 mark
I used the resources in the Geography department and found out that the government measures traffic density in Passenger Car Units (PCUs). Each type of vehicle has a different PCU value. The figures that I used were:

Vehicle Type	PCU value
Bicycles	0.5
Motorbikes	0.5
Cars	1
Vans and minibuses	2
Lorries and buses	3

The government have also produced numbers for different types of roads that tell us whether or not the road is too busy for its size. These sets of figures were on the same sheet and I've copied them in here.

Road Type/Width	Saturation value (PCUs per hour)
Up to 7.3 m (2 lane road)	375
Up to 10m (3 lane road)	688
Up to 14m (dual carriageway)	1512
Motorway	3024

This meant that I had to collect some data on traffic flow and convert it to a rate in PCUs per hour. The time taken for each individual survey needed to be long enough to get a representative sample, but not too long because the traffic density can change dramatically over a few minutes. My modelling system would need to accept the length of time for the survey and the number of each type of vehicle counted. This data must then be converted into a traffic density in PCUs per hour and compared to the maximum traffic density allowed on this width of road. It must report whether it is ok, or whether there is too much traffic. I could do all this using a paper based system by simply writing down the data and doing the conversion using a calculator. This method is cheap since the only cost is my time but it will take a long time to do and I will have to repeat the calculations several times to try out the effects of changing the road width or stopping lorries using this road. A better solution would be to do this using a spreadsheet model where the variables can be easily changed and the results seen much more quickly.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
I used the resources in the Geography department and found out that the government measures traffic density in Passenger Car Units (PCUs). Each type of vehicle has a different PCU value and there are also maximum values for different types of roads, to tell us whether or not the road is too busy for its size. These figures are shown in the printouts.

This meant that I had to collect some data on traffic flow and convert it to a rate in PCUs per hour. The time taken for each individual survey needed to be long enough to get a representative sample, but not too long because the traffic density can change dramatically over a few minutes. My modelling system would need to accept the length of time for the survey and the number of each type ofvehic1e counted. This data must then be converted into a traffic density in PCUs per hour and compared to the maximum traffic density allowed on this width of road. It must report whether it is ok, or whether there is too much traffic. It also needs to have the facility to change the width and type of road, so that it could be used anywhere rather than just my survey.

There are several ways that I could complete this modelling exercise. I could do all this using a paper based system by simply writing down the data and doing the conversion using a calculator. This method is cheap since the only cost is my time but it will take a long time to do and I will have to repeat the calculations several times to try out the effects of changing the road width or stopping lorries using this road. A second method would be to use a commercially available system. I have done some research on the internet and found packages such as TSIS (Traffic Software Integrated System) 5.0 and Synchro Plus SimTraffic 5.0. could easily do the job and provides “An animation file that demonstrates the real world traffic flow of the assigned traffic model”. This software is from America and will be very costly. A much better solution would be to do this using a simple spreadsheet model where the variables can be easily changed and the results seen instantly in either a written or graphical form.

C - Specification (3 marks)

3 Detailed and reasoned specification of how the solution will be judged as a success

2 Evidence of a specification of how the solution will be judged as a success

1 Some evidence of a specification

0 No specification

In this section the candidate shows that the solution to the problem has clear evaluation criteria. To gain 3 marks the candidate should demonstrate depth and sophistication in the criteria that will be used to judge the success of the final solution.

Evidence in report

1 mark minimum requirements - work showing less evidence can be worth no marks
The model should be easy to use and do the calculations very quickly so that it can be used over and over again to try lots of options

2 mark minimum requirements - work showing less evidence may be worth 1 mark
My evaluation will be based firstly on whether it works properly, secondly that it is faster to calculate and compare traffic density than a manual system and thirdly that my teacher (and other users) find it easy to use. It will also be easy to change variables like road width and show the output in graphs as well as numbers.

3 mark borderline - work showing less evidence may be worth 2 marks
My model should be

Easy to use so that the users are not confused

The input of data should be obvious and easy to follow

The calculations should be automatic so that no human errors are made

Be easy to change variables like road width

Clear output

Results should be clear and well formatted so that they can be understood easily

Show the output in graphs as well as numbers as many people understand pictures better than numbers

Faster

Input data within two minutes

Produce results figures quickly and at least within 30 seconds so that people get the results almost immediately are not kept waiting for a long time

D - Design of the ICT system (4 marks)

4 A clear and logically laid out design using a variety of techniques

3 A clearly laid out design using a variety of techniques

2 A clearly laid out design

1 Some evidence of a design

0 No evidence of a design

Having chosen the appropriate method and identified the requirements of the solution, the candidate should develop a planned design of the ICT system and describe the relationship between the various parts of the solution, using a variety of presentation techniques which could include flowcharts, algorithms and structure or systems diagrams. In this context a good design shows how the various parts of the newly designed system will fit together, from gathering the data all the way thorough to the final output.

For more than 1 mark, the method of solution should be laid out in a schematic way using flow charts, structure or system diagrams. It is likely that a clear system design, unless very simple, will be worth 2 mark if laid out in a single diagram, 3 marks if laid out as hierarchical diagrams or a written explanation is included and 4 marks if the rationale for the design is explained. The fourth mark can only be given if the work is clear, logically correct and uses diagrams as well as written explanations.

Evidence in report and diagrams

1 mark minimum requirements - work showing less evidence can be worth no marks
This could be a simple top-level system flow chart or simple structure diagram of the whole system, or simply a written description as below. There may be errors in the chart or diagram.

Having carried out my investigation and analysis, I have decided that my system will be based on a spreadsheet model. This will have input cells for the road width and the counts for each type of vehicle. As I have decided to base my counts on a 15 minute sample, I do not need to input the length of time taken, but that would be easy. When the user has done this, the spreadsheet will calculate the PCUs per hour for each type of vehicle, add them up to give a total traffic density and then compare this to the maximum allowed for that width of road. The user can also see what would happen if the road was widened, or reduce the flow of certain types of vehicles by banning them.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
This must be evidenced by a clear system diagram, structure diagram or flowchart of the whole system. It may alternatively be a written description as below, however there may be some errors in either the written or diagrammatic form.

Having carried out my investigation and analysis, I have decided that my system will be based on a spreadsheet model. This will have clear input cells for the road width and the counts for each type of vehicle. As I have decided to base my counts on a 15 minute sample, I do not need to input the length of time taken, but that would be an option for further development. When the user has entered the data the spreadsheet will calculate the PCUs per hour for each type of vehicle, adding them up to give a total traffic density and then compare this to the maximum allowed for that width of road. The spreadsheet should then show a message indicating if the road is saturated. Each time the model is run the user can see what would happen if the road was widened, or if the flow of certain types of vehicles was reduced by diverting them to other roads. The output should be available as graphs

3 mark minimum requirements - work showing less evidence may be worth 2 marks
This could be evidenced by an appropriate combination of a clear system diagram, structure diagram, flowchart of the whole system or a written description such as the one above. The use of more than one appropriate technique is required for the third mark. There may be a few errors in either format.

4 mark minimum requirements - work showing less evidence maybe worth 3 marks
The variety of techniques are clearly and logically laid out. Having chosen the appropriate method and identified the requirements of the solution, the candidate should develop a planned design of the ICT system and describe the relationship between the various parts of the solution, using a variety of presentation techniques which could include flowcharts, algorithms, structure diagrams, systems diagrams or written descriptions as below. There will be very few errors.

Having carried out my investigation and analysis, I have decided that my system will be based on a spreadsheet model. This will have input cells for the road width and the counts for each type of vehicle. As I have decided to base my counts on a 15 minute sample, I do not need to input the length of time taken, but that could be included both as an input cell and in the calculations. When the user has done this, the spreadsheet will calculate the PCUs per hour for each type of vehicle, add them up to give a total traffic density and then compare this to the maximum allowed for that width of road which will be in a lookup table. In this case, the option of a motorway is not sensible and so the largest element in the lookup table will be a dual carriageway.

Once the basic data for the survey has been entered, the user will need to see what would happen if the road was widened, or reduce the flow of certain types of vehicles by banning them. This could, for example, be based on banning commercial traffic in the peak travel periods, or banning cars and insisting on the use of park- and-ride schemes. These will be dependent on the findings of the model. If I am successful in creating a generalised model it could be used in any road traffic density analysis Output should be clear and easy to read in graphs and figures.

E(i) - Hardware resources required (2 marks)

2 An indication of the selection of hardware with justifications for the choice made

1 An indication of the selection of hardware

0 No indication of the selection of hardware

These marks are awarded for the selection of appropriate computer hardware including interfaces and control packages for measurement and control. In control tasks, marks for the choice of sensors and actuators would be given in sections E(iii) and E(vi).

Candidates are expected to explain reasons for selection of hardware resources for 2 marks, although selection may well be determined by availability. An understanding of fitness for purpose can be considered as evidence of selection of a computer system if the candidate has no sensible choice available.

Evidence in report

1 mark minimum requirements - work showing less evidence can be worth no marks
I have used Excel on a Pentium 3 system to create the work. This is a bit slow but it is fast enough, since the formulae in my spreadsheet are quite simple and don't need a lot of computer power. For the real system I would recommend the company buy a Bell 186 Pentium 4 system running Windows XP professional from Bell computers. I would suggest a hard disk of at least 20Gb. I would say they need to have an ink jet printer to print out the graphs in colour.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
I have used Excel on a Pentium 3 system to create the project. For the actual system for the council road traffic planner I would specify the use of a more up-to-date PC system such as a Dell 213 Pentium 4 system running Windows XP Professional as the quality of the output will be better and the planner may need to run several versions at the same time. The system is more than fast enough, since the formulae in my spreadsheet are quite simple and don't need a lot of computer power. The data used will only take up about 1Gb so the disk space of 40Gb on the Dell is more than enough. In order for the council to print hard copies of the graphs they will need a printer. I have researched several printers and have chosen a Lexmark 201 from Dabs Computer Systems. The Lexmark 201 printer produces good quality colour images in a short time, although a commercial system would possibly find it too slow. In that situation a laser printer would give greater speed, but colour lasers are very expensive to run.

E(ii) - Software resources required (2 marks)

2 An indication of the selection of software with justifications for the choice made

1 An indication of the selection of software

0 No indication of the selection of software

These marks are awarded for the selection of appropriate computer application software.

Evidence in report

1 mark minimum requirements - work showing less evidence can be worth no marks
I have chosen to use Excel instead of Lotus 123 as it lets me put formulae into my spreadsheet and the results come up straight away. It can also do graphs.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
I suggest that the user will need to purchase Excel 2000 as this is the spreadsheet package that I used to create the model. This has all the facilities that I needed to create a user-friendly spreadsheet. This includes locking cells so that the receptionists cannot alter the formulae already set up, coloured backgrounds and a wide range of different types of graph. For this task I used spreadsheets and bar charts. Of course, it also lets me put formulae into my spreadsheet, like other spreadsheet packages, and lets me use cut and paste to produce a report. Microsoft Excel is slightly easier to use than the alternative Lotus 123 and has more features. It is also more widely used so that the council workers may already be familiar with it.

E(iii) - Data collection, data capture and input (2 marks)

2 Evidence, with clear justifications, of the design of methods of collecting or inputting data

1 Evidence of the design of methods of collecting or inputting data

0 No evidence of the design of methods of collecting or inputting data

Typical evidence for this could be the inclusion of data capture forms for the spreadsheet. If there is no evidence to support the design of data capture forms then no marks can be awarded. When the data capture forms have a relationship with the data structures used then 1 mark can be awarded, 2 marks if the candidate explicitly links the format of the data capture forms with the data structures themselves.

In measurement and control tasks, these marks can be awarded for selection of sensors, sampling times, variables and calibration (as appropriate).

Evidence in report, data collection forms and screen dumps

1 mark minimum requirements - work showing less evidence can be worth no marks
This report must be supported by evidence of data collection forms or screen dumps

I decided that I would need a tally sheet to collect the data and I have included an example which also shows the other data collected. I also made sure that the spreadsheet was easy to fill in with the cells holding the data one above the other.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
This report must be supported by evidence of data collection forms or screen dumps

I decided that I would need a tally sheet to collect the data and I have included an example which also shows the other data collected. The information about the set of data is held at the top of the page, so that it can be filed away, and the space for tallying is enough for at least 200 in each type of vehicle. The types of vehicle are those that I found out when investigating the idea of PCUs.
I made sure that the spreadsheet was easy to use, and secure, by arranging the data that identified the model at the top of the screen arranging the data cells in a vertical column corresponding to the order on the tally form, locking al1 cells that aren't used for data entry, colour coding input and output cells and hiding the look-up tables off the bottom of the screen.

E(iv) - Data verification and/or validation (3 marks)

3	An understanding of and use of appropriate verification and/or validation techniques
2	A critique as to whether verification and/or validation techniques are appropriate
1	A simple mention of possible verification and/or validation techniques
0	No mention of possible verification and/or validation techniques

Not all applications software readily incorporates automatic or user defined verification and/or validation techniques. However, the candidate should be aware of how data is checked and, where appropriate, should have used methods to check that data inputted into their system is correct. Possible verification checks could include visual checking, double entry, etc. Whilst validation could include range checks, etc. For any marks to be awarded there must be more than one technique considered or used

In measurement and control tasks, these marks can be awarded for use of appropriate techniques such as range checks to ensure that captured data is plausible.

Evidence in report and screen dumps, annotated printouts and data collection sheets showing validation

1 mark minimum requirements - work showing less evidence can be worth no marks
It is important to make sure that the data is correct, otherwise the output from the model could be incorrect and this could give the wrong results to the road planners. One way to do this is to verify the data by checking data you typed in against the tally sheet. Another way is to get the computer not to accept figures that are too high or too low. This is called validation. The computer checks against numbers that you have set.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
The model I have chosen uses a random number generator to produce sample input data. This data is limited to possible whole number values between 1 and 100 by the formula =INT(RAND()*100). This means that it is not sensible to use validation tests, such as range checks, on this data. In fact there really is a range check anyway as the smallest number possible is 1 and the largest number possible is 100. For the same reason verification is also not sensible as there are no source documents to check against. Verification would normally check that the data input to the computer system is the same as the data collected. Here the traffic density generated is automatically entered exactly the same so there is no need for verification.

3 mark minimum requirements - work showing less evidence may be worth 1 mark
I double-checked all the data as it was typed in by comparing what was on the screen with the information on the tally sheet. Because this had the same layout as the entry screen it was easy to see if any errors had been made. As an additional check I printed out the spreadsheet and checked the data again. As you can see from the highlighted printouts and tally sheet on the next page, this was totally correct apart from one figure. I edited this so that it was correct. It is important to make sure that the data is correct, otherwise the output from the model could be incorrect and this could give the wrong results to the road planners.

I also ensured that the input data was sensible by using the following formulae to check that the counts for different types of vehicle were sensible. I did this by setting up a lookup table at the bottom right of the spreadsheet (F25 to F31 in the printout below) and changing the calculations in cells D11 to D17 from the form =Bll*Cll to
=IF(AND(C11>0,C11 <F25+1),INT(C11)*B11,'error')

This checks that the data entered in C11 is positive, less than the maximum for the type of vehicle, is made into an integer. If anything outside the range is entered then this formula returns 'error'. You can see the evidence that this formula works in the printouts below where I tried both a possible value and an invalid value.

E(v) - Data and/or program structures (2 marks)

2 Justification given for data and/or program structures used

1 Appropriate data and/or program structures designed and used

0 No evidence of appropriate data and/or program structures

In measurement and control tasks, these marks can be awarded for the appropriate program structures and techniques, such as procedures, as well as for data structures such as files for data logging.

Evidence in report and printouts, screen dumps, listings and schematic structure

1 mark minimum requirements - work showing less evidence can be worth no marks
Evidence of the construction and use of the spreadsheet with a structure appropriate to the application, will be sufficient for 1 mark - see printouts; however it should show the formula used as well as showing the data. Headings should also be shown to show relevance to the formula

2 mark minimum requirements - work showing less evidence may be worth 1 mark
Evidence of the construction and use of the spreadsheet with a structure appropriate to the application is needed together with justification for that structure.

All to A17 are the types of vehicles while B11 to B17 are the PCU values for each type.
E11 to E17 are the counts that I got in my survey - these are the only cells that can be altered, except for the title cells.
D 11 to D 17 convert these counts into a PCU count, and Ell to E17 convert these PCU counts into hourly counts by using formulas. E19 is the total hourly PCU count

E21 tells me if the road is OK or over-saturated. It does this by comparing E19 (the hourly count) to D5, which is total maximum PCUs per hour for the size of road, using the lookup table at the bottom left of the spreadsheet. If it is over-saturated it displays "too high", while if it is not over-saturated then it displays "OK".

D5 is the maximum PCUs per hour for the size of road. At first I typed this in from the table of data as 375, because Alexandra Road was 6.3 metres wide at the point I did my survey, but I found that when I widened the road I had to change this number by hand. I used a function from Excel instead, which is =VLOOKUP(D3,B25:C27,2). D3 is the width of the road and the lookup table is from B25 to C27. The saturation value is in column 2.

E(vi) - Output format (3 marks)

3 Justification for the design and use of a range of customised output formats

2 Evidence of the design and use of a range of customised output formats

1 Evidence of the use of a range of default outputs formats

0 No evidence of output formats

In this section the candidate should be aware that the default outputs from application software are not always appropriate and that the output should be designed with the needs of the intended audience in mind, i.e. in spreadsheets the standard column width is often inappropriate and results may need to be highlighted in some way. In measurement and control tasks, these marks can be awarded for the selection of appropriate physical outputs (such as lights, sound or movement) as well as printed output.

The majority of output provided by candidates will have been significantly modified from the software default outputs so careful checking is needed to establish design and fitness for purpose before awarding 2 marks for output. 3 marks can be awarded when candidates have clearly explained why the output formats were so designed.

Evidence in report and screen dumps, print-outs, photographs

1 mark minimum requirements - work showing less evidence could be worth no marks
Evidence of the output of the spreadsheet (worksheet and chart) will satisfy the requirements for 1 mark if only default settings are used. For example, all columns are printed and it is clear that they are not modified for width

2 mark minimum requirements - work showing less evidence may be worth 1 mark
As you can see I drew some pie charts to show which types of vehicles were the most common. From the charts in the printouts you can see that the largest group is cars, both by actual number and by PCU. As you can see the worksheet has been customised to suit the users.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
My spreadsheet is designed to show the outputs as a highlighted column of figures to the right of the screen. This makes them easy to pick out, but many people have difficulty in thinking what these figures mean in relation to each other. I therefore decided to show the output as graphs as well as just the spreadsheet numbers.

The results of my survey showed me that the road is very much over-saturated at the morning peak time. The total PCUs is about 3 times the maximum value allowed. This means that something should be done to reduce the traffic flow at these times. I decided first of all to identify the percentages each type of vehicles, firstly by numbers and then by PCUs, to try to work out what I could change to try to reduce the saturation level. This could be done with bar or pie charts, because this is discrete data. I decided that pie charts would be better, since some of the numbers are very small and would be more difficult to compare on a bar chart. This can be seen in the printouts.

From these charts it can be seen that the largest group is cars, both by actual number and by PCU.

F - Testing (4 marks)

4 Evidence of testing of the solution using a clearly defined, comprehensive and fully justified strategy

3 Evidence of testing of the solution using a clearly defined and comprehensive strategy

2 Evidence of testing of the solution using a defined strategy

1 Evidence of some testing of the solution

0 No evidence of any testing of the solution

To be worth 4 marks there must be a justified and appropriate testing strategy, with evidence of its use. If the strategy does not cover most of the requirements, or is not explained clearly then only 2 or 3 marks can be awarded. Random testing can be awarded only 1 mark at the most, but candidates must indicate in the report that testing has taken place if this mark is to be awarded.

Comprehensive at this level should include testing a range of data input (valid, invalid etc.), correct output and most of the specification.

Evidence in report and printouts showing testing

It is essential to have evidence of the testing that was carried out to gain marks. An absence of printouts or screen dumps (as appropriate) leads to an absence of marks. To gain any marks, candidates are required to show that they understand the nature of testing, i.e. that they should know what the outcome will be before a test is carried out. Simply showing that something works is not a test.

1 mark minimum requirements - work showing less evidence can be worth no marks
I tried out the model by using the data that I had collected, then changing some of the figures. I thought that the traffic density would increase if I put more vehicles in, and it did increase. It dropped when I removed some of the vehicles. This can be seen in the printouts.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
I decided to test the system by using a range of data that would include examples that were inside and outside my specifications. I tested the data input part of the system, then the output. First of all I used valid data, entering vehicle counts correctly. This worked fine. I then made up some false data, using negative numbers, decimals and huge numbers. The validation checks prevented these from being entered. I then put different data into the model, to represent different possible strategies to reduce traffic density. I knew what these figures should come up with, and all the outputs were as expected. For example if I reduce the road size by half the traffic density will double. This can be seen in the printouts.

Test no.	Test	Expected result	Actual result	Evidence
1	Valid data	Numbers added	Numbers added	Printout 1
2	Invalid data	Error message	Error message	Printout 2
3	Road size reduced	Traffic density rise	Traffic density rose	Printout 3
4	Output button	Graph produced	Graph produced	Printout 4

3 mark minimum requirements - work showing less evidence may be worth 2 marks
I decided to test the system by using a range of data that would include examples that were inside and outside my specifications. I tested the data input part of the system, then the output. First of all I used valid data, entering vehicle counts correctly. This worked fine. I then made up some false data, using negative numbers, decimals and huge numbers. The validation checks prevented these from being entered. I then put different data into the model, to represent different possible strategies to reduce traffic density. I knew what these figures should come up with, and all the outputs were as expected. For example if I reduce the road size by half the traffic density will double.

Test no.	**Test Input data**	**Expected result**	**Actual result**	**Evidence**
1	Valid data 25 cars	25 cars added	25 cars added	Printout 1
2	Invalid data 3000 cars	Error message	Error message	Printout 2
Test no.	**Test changing width**	**Expected result**	**Actual result**	**Evidence**
3	Width 5.5 metres	"Too High"	"Too High"	Printout 3
4	Width 7.5 Metres	"OK"	"OK"	Printout 4
Test no.	**Remove Vans**	**Expected result**	**Actual result**	**Evidence**
5	Delete all 2s from data	"OK"	"OK"	Printout 5
6	Delete Lorries	"OK"	"OK"	Printout 6
Test no.	**Increase cars**	**Expected result**	**Actual result**	**Evidence**
7	Double cars	"Too High"	"Too High"	Printout 7
Test no.	**Increase cars**	**Expected result**	**Actual result**	**Evidence**
8	Output button	Graph produced	Graph produced	Printout 8
Test no.	**Specification**	**Expected result**	**Actual result**	**Evidence**
9	Input data in 2 min	Data input in 2 min	Data input in 2 min	Printout 9
10	Produce figures 30 sec	Figures in 30 sec	Figures in 10 sec	Printout 10
11	Output graph	Graph output	Graph output	Printout 11

4 mark minimum requirements - work showing less evidence may be worth 3 marks
I decided to test the system by using a range of data that would include examples that were inside and outside my specifications. I tested the data input part of the system, then the output. First of all I used valid data, entering vehicle counts correctly. This worked fine. I then made up some false data, using negative numbers, decimals and huge numbers. The validation checks prevented these from being entered. The road width was tested in similar ways, with valid and invalid data for this variable. Again, the results were as I expected. I then put different data into the model, to represent different possible strategies to reduce traffic density. These were removing commercial vehicles, widening the road and enforcing a park-and-ride scheme. I knew what these figures should come up with, and all the outputs were as expected.

Test no.	**Test Input data**	**Expected result**	**Actual result**	**Evidence**
1	Valid data 25 cars	25 cars added	25 cars added	Printout 1
2	Invalid data 3000 cars	Error message	Error message	Printout 2
Test no.	**Test changing width**	**Expected result**	**Actual result**	**Evidence**
3	Width 5.5 metres	"Too High"	"Too High"	Printout 3
4	Width 7.5 Metres	"OK"	"OK"	Printout 4
Test no.	**Remove Vans**	**Expected result**	**Actual result**	**Evidence**
5	Delete all 2s from data	"OK"	"OK"	Printout 5
6	Delete Lorries	"OK"	"OK"	Printout 6
Test no.	**Increase cars**	**Expected result**	**Actual result**	**Evidence**
7	Double cars	"Too High"	"Too High"	Printout 7
Test no.	**Increase cars**	**Expected result**	**Actual result**	**Evidence**
8	Output button	Graph produced	Graph produced	Printout 8
Test no.	**Specification**	**Expected result**	**Actual result**	**Evidence**
9	Input data in 2 min	Data input in 2 min	Data input in 2 min	Printout 9
10	Produce figures 30 sec	Figures in 30 sec	Figures in 10 sec	Printout 10
11	Output graph	Graph output	Graph output	Printout 11

Justifications are provided on each test printout.

G - User documentation (3 marks)

3	Clear and logical instructions as to how to use the ICT system, and how to amend the ICT system if necessary including the technical aspects of the use the ICT system.
2	Clear instructions as to how to use the ICT system, and how to amend the ICT system if necessary
1	Some simple instructions as to how to use the ICT system
0	No evidence of any user documentation

To be awarded marks in this section there must be separate and identifiable documentation that would enable an unfamiliar user to operate and adapt the ICT system designed.

Trivial documentation which simply gives instructions on how to use the software and is inadequate for an unfamiliar user to make appropriate use of the system that has been created can be awarded no marks.

There is no need for candidates to include any commentary on their documentation within the report, although there may be justification for the content of the documentation. This is not necessary for the award of marks.

The user documentation including the technical aspects does not need to occupy more than a side or two of A4. The expectation is that, in each case, the support given would be sufficient to enable an unfamiliar user to run the system and carry out appropriate basic functions.

Evidence in supporting documentation and possibly report

1 mark minimum requirements - work showing less evidence can be worth no marks
This will be task orientated, showing how the software is used for the specific task. It will probably give instructions that allow an unfamiliar user to run the system (assuming that Windows was already running) by double-clicking on the icon, to input the data, to generate a graph, and to print the spreadsheet and graph.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
In addition to the work above, the documentation should show how to modify variables such as road width or change the type of graph produced.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
In addition to the work of both sections above, instructions on the technical aspects are included This section will be more system-orientated and provide clear and logical instructions. It might provide full details that allow an unfamiliar user to modify an existing formula and change the lookup table.

H - Evaluation (3 marks)

3	An evaluation of the ICT system based on the specification with suggestions for future refinements
2	An evaluation of the ICT system based on the specification
1	Some evaluation of the ICT system, without reference to the specification
0	A cursory or no evaluation of the ICT system

In this section the candidate should refer to the evaluation criteria provided in Section C of the assessment criteria.

The maximum mark available if no evaluation criteria are given is 1. The criteria for evaluation must have been defined prior to implementation if more than 1 mark is to be awarded, this is normally done in Section C – Specification of the report. If 3 marks are to be awarded then the suggestions for refinements should clearly arise from the evaluation.

Evidence in report

1 mark minimum requirements - work showing less evidence can be worth no marks
My solution is successful because the testing shows that it does work properly. As my system took less than I minute to type in all the data and get the details displayed on screen, this was a lot quicker than it would have taken to calculate by hand, even using a calculator. Three of my friends, and my geography teacher, tried using the system. They all found it very easy to use.

Because of all this I have decided that my solution is successful.

2 mark minimum requirements - work showing less evidence may be worth 1 mark
When I first investigated this project I decided that I would evaluate it by comparing it to the following points:

Whether it works properly, that it is faster to calculate and compare traffic density than a manual system that my teacher (and other users) find it easy to use, will be easy to change variables like road width and show the output in graphs as well as numbers.

The testing shows that it does work properly, since I tried it with a range of different data and it always gave the response that I expected. As my system took less than 1 minute to type in all the data and get the details displayed on screen, this was a lot quicker than it would have taken to calculate by hand, even using a calculator. Three of my friends, and my geography teacher, tried using the system. They all found it very easy to use.

Because of all this I have decided that my solution is successful.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
When I first investigated this project I decided that I would evaluate it by comparing it to the following points:

Easy to use

- *The input of data should be obvious and easy to follow*
- *The calculations should be automatic*
- *Be easy to change variables like road width*

The data entry screen was tested to see if was working then three of my friends, and my geography teacher, tried using the system. They all found it very easy to use. Their statements are in the printouts rating the system on a number basis. The calculations happened immediately and were correct, this is in the testing section. The testing showed that it does work properly, since I tried it with a range of different data and it always gave the response that I expected.

- *Clear output*
  - *Results should be clear and well formatted*
  - *Show the output in graphs as well as numbers*

The results were judged easy to understand by the people who checked it and they all felt that the graphs helped in understanding.

- *Faster*
  - *Input data within two minutes*
  - *Produce results figures quickly and at least within 30 seconds*

My system took less than 1 minute to type in all the data and get the details displayed on screen, this was a lot quicker than it would have taken to calculate by hand, even using a calculator. This is also within the 2 minutes I set in the specification. The data also displayed almost instantly which is faster than the 30 seconds I said in my specification.

There are, however, several ways in which my system could have been improved. To make it more flexible I could have had a data entry cell for the time, and length, of the survey. I could also have set up cells to act as labels for the graphs.

A possible source of error was the manual surveying. It was quite likely that errors were made in primary data recording, such as missing vehicles or entering them in the wrong box. My visual check verification made sure that I transferred the data collected in an accurate way, but errors could have happened earlier. It could be more effective, and cheaper in the long run, to use remote sensors to count the number of vehicles as this would be more accurate (I found that sometimes I couldn't keep up with the counting) and would be cheaper than paying people to do the counting. I have seen the double black wires across roads which I think are pressure sensors connected to a data logger.

Sometimes the users of the system did not understand what to do and had to refer to the paper user guide. This took them quite a lot of time. It would be better if there was an on-line help system. The user could then just click on the ‘help’ icon and type in the word or phrase that he needed help with. The information would then come up on the screen with actual examples. This would be much better. The user could also keep this window open and refer back to it very easily.

However, despite these possible improvements, I have decided that my solution meets my evaluation criteria and is successful.

J - Communication within the report (3 marks)

3	Presentation of the report is of a high quality and uses a varied range of techniques. The needs of the intended audience are catered for and spelling, punctuation and grammar is used with consistent accuracy
2	Presentation of the report is good and uses a range of techniques, and spelling, punctuation and grammar is used with accuracy
1	Presentation of the report uses a limited range of techniques, and spelling, punctuation and grammar is used with reasonable accuracy
0	Presentation of the report is basic with inaccurate use of spelling, punctuation and grammar

1 mark minimum requirements - work showing less evidence can be worth no marks
A report that uses some of the heading supplied but has a number of spelling errors and generally seems to just about communicate the concepts

2 mark minimum requirements - work showing less evidence may be worth 1 mark
A report that uses all the headings supplied and has few if any spelling errors or grammatical errors. The headings are clear and the text is understandable. Diagrams and screen shots are reasonably used.

3 mark minimum requirements - work showing less evidence may be worth 2 marks
Using sensible headings there are almost no spelling or grammatical errors. Each section is clear and the wording clearly indicates that the candidate can communicate their ideas in an unambiguous manner. Diagrams and screen shots are well used to illustrate the points made in the report and, in general, the report is well written.