

Pearson Edexcel GCE

Applied Information and Communication Technology Unit 3: The Knowledge Worker

22–26 May 2017

Time: 2 hours 30 minutes

Paper Reference

6953/01

You must have:

Cover sheet, short treasury tag, TP_exam.xlsx,
NFR_Ruth_exam.txt.

Instructions

- Complete your candidate details on the cover sheet provided.
- All printouts must contain your name, candidate number, centre number and activity number.
- At the end of the examination:
 - all printouts should be placed in the correct order
 - use a treasury tag to attach your printouts (**as shown**) to page 2 of the cover sheet.

Information

- The total mark for this paper is **90**.
- There are **four** activities in this examination totalling **88** marks.
Two further marks are allocated to Standard Ways of Working.
- The marks for **each** question, within an activity, are shown in brackets
 - use this as a guide as to how much time to spend on each question.
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
 - you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.

Advice

- Read through the Scenario carefully.
- Work through the activities in order.
- Attempt **ALL** activities.
- Label your printouts clearly as instructed.
- Printing must be undertaken within the examination period.

Turn over ►

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Scenario

Note: the information contained in this scenario is fictitious. Much of the information has been adapted to provide a model of a suitable complexity.

Twisted Pear Reunion Tour

Formed in 1998, the Leeds based rock band 'Twisted Pear' had the majority of its success between 2004 and 2008. The band's most successful year was 2006 with a seminal appearance at the inaugural Marker's Farm Festival, later to be known as 'Rockstock'. This brought the band to the attention of rock fans all over the world. There followed the hugely successful European Tour with its spectacular laser show.

For the next two years the band achieved success after success but in June 2008 announced it was splitting up. Their management cited 'musical differences' as the reason for the split but this is probably a music industry euphemism for 'constant bickering'. Some of the members joined other bands and some tried their hand at a solo career. None of them had the success of 'Twisted Pear' in its prime. For the last ten years the band members have been marking time at the outer reaches of the music industry.

The idea to reform 'Twisted Pear' came from a chance meeting of three of its members. Former band members Stacey Beardmore and brothers Neil and Terry White met when their new bands were playing on the same bill in Stockton-on-Tees. After their sets the three got together for a 'jam' and started to play some of their old numbers. Terry got in touch with the other band members and plans for a big reunion tour got underway. The band was to play all its old anthems and a few new ones penned by Terry and Neil.

This was where the first problem came to light. Everyone associated with the band recognised that the main reason for its success had been the distinctive voice of vocalist Ruth Nixon. Ruth was a rarity in rock music as she had a range of four octaves with a deepness and rough edge to her voice that made it instantly recognisable. The band's numbers were written to use the full range of Ruth's voice, which ranged from low F2 to high F6. Sadly, advancing years and the rock and roll lifestyle has had a disastrous effect on her voice and she can no longer reach the top octave of her range.

It was the band's drummer, Mel Green, who came up with the solution. When the band broke up Mel set himself up as a music producer. Several years ago Mel met two Cambridge graduates who were studying singers to discover what makes a voice unique. They had invented a device that could identify and isolate 20 different sources of distortion, which when applied to the initial sound wave would produce a singer's distinctive sound. They had labelled each of the sources of distortion with a letter of the alphabet.

Some time later, they found that by passing the distortions through a series of magnetic fields of differing intensity and direction they could alter the relative magnitude of the distortions. This would effectively change the characteristics of a voice. The device had four controls that ranged from position 0 to 11 enabling the operator to have over 20,000 different combinations of settings. The graduates did explain how these settings worked but it was too much for Mel. There was a fifth control on the device, which could change the frequency (and therefore the note) of the initial sound wave.

The graduates contacted Mel because they wanted to see if they could invent a voice using their own singing voices and the device. The experiment failed because they found that in any voice only a few of the 20 distortions they had isolated were dominant.

The others produced so little distortion that they could not be magnified enough relative to the dominant ones. In simple terms, this meant that you needed a decent singing voice in the first place.

Mel realised that the device could make Ruth's voice sound like it used to. Ruth can no longer reach the top octave of her range. However, the device could be set up to extend her current vocal range.

When she needed to sing in the top octave, she would flick a switch to feed the microphone signal through the device. She could then sing an octave lower and sound like she used to.

Mel contacted the graduates and they lent him the device. They also sent data from an analysis of a recording of Ruth's voice, which they had measured as part of their initial experiment. They had found that in Ruth's voice the dominant distortion sources were the ones they labelled A, F, L, R and V. Mel found that controls 1 and 2 on the device had the greatest effect on distortions A, F and L while controls 3 and 4 had the greatest effect on distortions L, R and V. He also found that the frequency should be set first as this has an effect on all the other controls.

The sound engineer for the tour was made responsible for the device. He quickly realised that setting the controls by trial and error would take a lot of Ruth's time. He decided to create a model and input the data from the graduates' analysis of Ruth's old singing voice to work out the settings theoretically. He also needed to have data on the effects of each setting. He fed the output from a synthesiser with similar dominant distortions to Ruth's current voice through the device and measured the gain for each note on each distortion. He incorporated this into the model.

As the tour approached, the sound engineer found himself too busy to complete the model. He has employed you as an assistant and has asked you to complete the model and find the best settings for Ruth's voice. To help you to understand the model he has left you a few notes.

Worksheet	Description
Control Page	This worksheet will be where the controls are set. It will contain the differences between the initial data of Ruth's voice and the simulated data produced by the device. The smaller the differences are, the closer Ruth's voice will be to how she used to sound.
Difference	This worksheet contains difference tables.
NFR(Ruth)	The data supplied by the graduates will be entered here.
O2–O4	I have used these worksheets to split the data into octaves and to produce charts of the distortions.
O5	This worksheet is similar to O2 to O4 except it also contains the calculated data for the same octave.
DistA, DistL, DistF, DistR and DistV	These worksheets contain lookup tables.

Some cells in the model are password protected. Should you wish to experiment with the model, the password is *edexcel*. Be aware that if you change the contents of any protected cell the model may not work.

Instructions to Candidates

All printouts **MUST** have a header and a footer. The header must contain the activity number. The footer must contain your name, candidate number and centre number.

Minimum font size of 10 should be used throughout.

All spreadsheet printouts should show gridlines and row and column headers.

Provide printouts for all activities.

For some of your spreadsheet printouts you may need to adjust column widths. To do this you will need to unprotect the worksheets. The password is *edexcel*.

Activity 1 – Understanding the situation (suggested time 25 minutes)

Read the scenario carefully.

On **one** sheet of A4:

- (a) In a maximum of two sentences, give the main objective of using the model and how you will use the model to achieve it. (2)
- (b) Using a numbered list, state **10** pieces of information from the scenario that are important to the working of the model. (10)
- (c) In a table, list **two** data sources you will use, state the data each provides and give a brief evaluation of its appropriateness. (6)

Save and print your work.

(Total for Activity 1 = 18 marks)

Activity 2 – Completing the model (suggested time 40 minutes)

You should ensure that each printout is on **one** sheet of A4 only.

The model is stored as **TP_exam.xlsx**

- Open the spreadsheet model and familiarise yourself with it.

Note: you may need to unprotect the sheet to do this.

(a) NFR(Ruth)

The Cambridge graduates have supplied data about the relative distortions of Ruth's singing voice.

You will find this data in the text file **NFR_Ruth_exam.txt**

- Import this data into cells A9:J58 of the 'NFR(Ruth)' worksheet.
- Print off** columns A–J and rows 9–20 and 50–58 of the 'NFR(Ruth)' worksheet showing **data**.

(1)

(b) DistA

Cells A9–M22 of the 'DistA' worksheet contain a lookup table. The values show the gain for distortion A for each note in the top octave of Ruth's range. Row 9 contains headings representing the position of the relevant control. For example, the gain for note F5 with a control in position 5 (cell G10) would be 1.9655 (rounded value). Cells K22:N22 of the 'O5' worksheet hold the offset values to the table.

- Enter a formula into cell B24 of the 'DistA' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O5' worksheet.
- Replicate this formula to cell E35.
- Print off** columns A, B and E and rows 23 to 35 of the 'DistA' worksheet showing **formulae**.

(8)

(c) DistF

Cells A9–M22 of the 'DistF' worksheet contain a lookup table. The values show the gain for distortion F for each note in the top octave of Ruth's range. Cells K22:N22 of the 'O5' worksheet hold the offset values to the table.

- Enter a formula into cell B24 of the 'DistF' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O5' worksheet.
- Replicate this formula to cell E35.
- Print off** columns A, B and E and rows 23 to 35 of the 'DistF' worksheet showing **formulae**.

(2)

(d) **DistL**

Cells A9–M22 of the 'DistL' worksheet contain a lookup table. The values show the gain for distortion L for each note in the top octave of Ruth's range. Cells K22:N22 of the 'O5' worksheet hold the offset values to the table.

- Enter a formula into cell B24 of the 'DistL' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O5' worksheet.
- Replicate this formula to cell E35.
- Print off** columns A, B and E and rows 23 to 35 of the 'DistL' worksheet showing **formulae**.

(2)

(e) **DistR**

Cells A9–M22 of the 'DistR' worksheet contain a lookup table. The values show the gain for distortion R for each note in the top octave of Ruth's range. Cells K22:N22 of the 'O5' worksheet hold the offset values to the table.

- Enter a formula into cell B24 of the 'DistR' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O5' worksheet.
- Replicate this formula to cell E35.
- Print off** columns A, B and E and rows 23 to 35 of the 'DistR' worksheet showing **formulae**.

(2)

(f) **DistV**

Cells A9–M22 of the 'DistV' worksheet contain a lookup table. The values show the gain for distortion V for each note in the top octave of Ruth's range. Cells K22:N22 of the 'O5' worksheet hold the offset values to the table.

- Enter a formula into cell B24 of the 'DistV' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O5' worksheet.
- Replicate this formula to cell E35.
- Print off** columns A, B and E and rows 23 to 35 of the 'DistV' worksheet showing **formulae**.

(2)

(g) **Difference**

The values calculated in the 'Difference' worksheet are the differences between original values and simulated values. They are calculated by taking the simulated value from the original value, squaring it and then taking the square root of the answer.

The original and simulated values for frequency and distortions A, F, L, R and V are in the 'O5' worksheet.

The values for frequency difference are calculated in column B. For example, the original value for the frequency of note F5 is in cell 'O5'!B10 and the simulated value is in cell 'O5'!B23.

- Enter a formula into cell B10 of the 'Difference' worksheet to calculate the frequency difference for note F5.
- Replicate this formula to B22.

The distortion difference for distortions A, F, L, R, and V are held in columns C to G respectively.

- Enter a formula into cell C10 of the 'Difference' worksheet to calculate the distortion A difference for note F5.
- Replicate this formula to G22.
- Enter a formula into cell B23 to calculate the average frequency difference.
- Replicate this formula to G23.
- Print off** columns A–D and G and rows 9–23 of the 'Difference' worksheet showing **formulae**.

(9)

(h) **Using the model**

There are five spinners on the 'Control Page' worksheet. The top spinner is to adjust the frequency gain. The other four spinners will set Control Settings 1–4.

- Set the Frequency Gain spinner so that the frequency difference in cell A21 is as small as possible.
- Set the Control Setting spinners (1–4) so that the A, F, L, R and V distortion differences in B21:F21 are as small as possible.
- Screenshot the 'Control Page' worksheet with your solution showing and paste it into a document. Make sure that all spinner settings, differences and charts can be seen. It is not necessary to include the 'Twisted Pear' banner.
- Save** and **print** the document.

(11)

(i) **Printouts**

- Collect your printouts together. Ensure you have printed them correctly and that they are in the order you have been asked to print them.

(3)

(Total for Activity 2 = 40 marks)

Activity 3 – Guitar (suggested time 40 minutes)

Throughout the successful years of the band, Terry White played an old Rickenbacker 325 guitar. This produced a distinctive and unique sound. Unfortunately long distance tours, coupled with Terry's somewhat boisterous stage presence, had a bad effect on the Rickenbacker. It is now unplayable. As a replacement he bought a Fender Stratocaster that never quite produced the same sound as the Rickenbacker.

Terry asked the sound engineer if the device used to modify Ruth's voice could be used to make the Stratocaster sound like the Rickenbacker.

The sound engineer found that the dominant distortions for the Rickenbacker are G, L and T. He has entered the data for both the Rickenbacker and the Stratocaster into new worksheets in the spreadsheet.

(a) DistG (Rick)

Cells A9–M58 of the 'DistG (Rick)' worksheet contain a lookup table. The values show the gain for distortion G for each note on the guitar. Row 9 contains headings representing the position of the relevant control. For example, the gain for note F2 with a control in position 5 (cell G10) would be 0.0601 (rounded value). Cells N23:Q23 of the 'O (Rick)' worksheet hold the offset values to the table.

- Enter a formula into cell N10 of the 'DistG (Rick)' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O (Rick)' worksheet.
- Replicate this formula to cell Q58.
- Print off** columns A, N and Q rows 9–11 and 55–58 of the 'DistG (Rick)' worksheet showing **formulae**.

(2)

(b) DistL (Rick)

Cells A9–M58 of the 'DistL (Rick)' worksheet contain a lookup table. The values show the gain for distortion L for each note on the guitar. Cells N23:Q23 of the 'O (Rick)' worksheet hold the offset values to the table.

- Enter a formula into cell N10 of the 'DistL (Rick)' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O (Rick)' worksheet.
- Replicate this formula to cell Q58.
- Print off** columns A, N and Q rows 9–11 and rows 55–58 of the 'DistL (Rick)' worksheet showing **formulae**.

(2)

(c) **DistT (Rick)**

Cells A9–M58 of the 'DistT (Rick)' worksheet contain a lookup table. The values show the gain for distortion T for each note on the guitar. Cells N23:Q23 of the 'O (Rick)' worksheet hold the offset values to the table.

- Enter a formula into cell N10 of the 'DistT (Rick)' worksheet to look up the distortion gain depending on the offset value for Control 1 in the 'O (Rick)' worksheet.
- Replicate this formula to cell Q58.
- Print off** columns A, N and Q rows 9–11 and rows 55–58 of the 'DistT (Rick)' worksheet showing **formulae**.

(2)

(d) **Difference (Rick)**

The values calculated in the 'Difference (Rick)' worksheet are the differences between the Rickenbacker values and the simulated values. They are calculated by taking the simulated value from the Rickenbacker value, squaring it and then taking the square root of the answer.

The Rickenbacker and simulated values for frequency and distortions G, L and T are in the 'O (Rick)' worksheet.

The values for frequency difference are calculated in column B.

- Enter a formula into cell B10 of the 'Difference (Rick)' worksheet to calculate the frequency difference for note F2.
- Replicate this formula to B58.

The distortion difference for distortions G, L and T are held in columns C to E respectively.

- Enter a formula into cell C10 of the 'Difference (Rick)' worksheet to calculate the distortion G difference for note F2.
- Replicate this formula to E58.
- Enter a formula into cell B59 to calculate the average frequency difference.
- Replicate this formula to E59.
- Print off** columns B and E and rows 9–11 and 55–59 of the 'Difference (Rick)' worksheet showing **formulae**.

(3)

(e) **Using the model**

There are five spinners on the 'Control Page (Rick)' worksheet. The top spinner is to adjust the frequency gain. The other four spinners will set Control Settings 1–4.

- Set the Frequency Gain spinner so that the frequency difference in cell A21 is as small as possible.
- Set the Control Setting spinners (1–4) so that the G, L and T distortion differences in B21:D21 are as small as possible.
- Screenshot the 'Control Page (Rick)' worksheet with your solution showing and paste it into a document. Make sure that all spinner settings, differences and charts can be seen. It is not necessary to include the 'Twisted Pear' banner.
- Save** and **print** the document.

(5)

(f) **Printouts**

- Collect your printouts together. Ensure you have printed them correctly and that they are in the order you have been asked to print them.

(1)

(Total for Activity 3 = 15 marks)

***Activity 4 – Report (suggested time 35 minutes)**

Write a report for the band and the sound engineer.

The report should include:

- a suitable title and section headers
- an introduction explaining what the model does
- your suggestions, with justifications, for the settings to simulate the sound of Ruth's singing voice
- your suggestions, with justifications, for the settings to simulate the sound of Terry's Rickenbacker guitar
- graphical data to demonstrate the closeness of the simulations
- reasons why the simulations may not be totally accurate
- an evaluation of the model and suggestions on how to improve it.

Proof read your report.

Marks will be awarded for the quality of your written communication.

Save and print your work.

(Total for Activity 4 = 15 marks)

Standard Ways of Working

All printouts must contain the activity number, your name, candidate number and centre number.

Pages must be securely fastened to the cover sheet and in the correct order.

Minimum font size of 10 should be used for all word processed documents.

(Standard Ways of Working = 2 marks)

TOTAL FOR PAPER = 90 MARKS