

# Pearson BTEC Level 3 Nationals Extended Diploma

**Window for supervised period:**

**Monday 7 December 2020 – Wednesday 20 January 2021**

Paper Reference **31725H**

## **Engineering**

**Unit 6: Microcontroller Systems for Engineers**

**Part S**

### **Information Booklet**

**Do not return this Information Booklet with Electronic Task Booklet**

### **Instructions**

- This information may be required for learners producing a solution to the task using individual electronic components and/or a prototyping board.  
**It is not required by learners producing a solution to the task using only modular electronic devices and project boards.**
- If required, read the information carefully.
- You must **not** write your answers in this booklet.
- Only your answers given in the Electronic Task Booklet and audio-visual file will be marked.

*Turn over* ►

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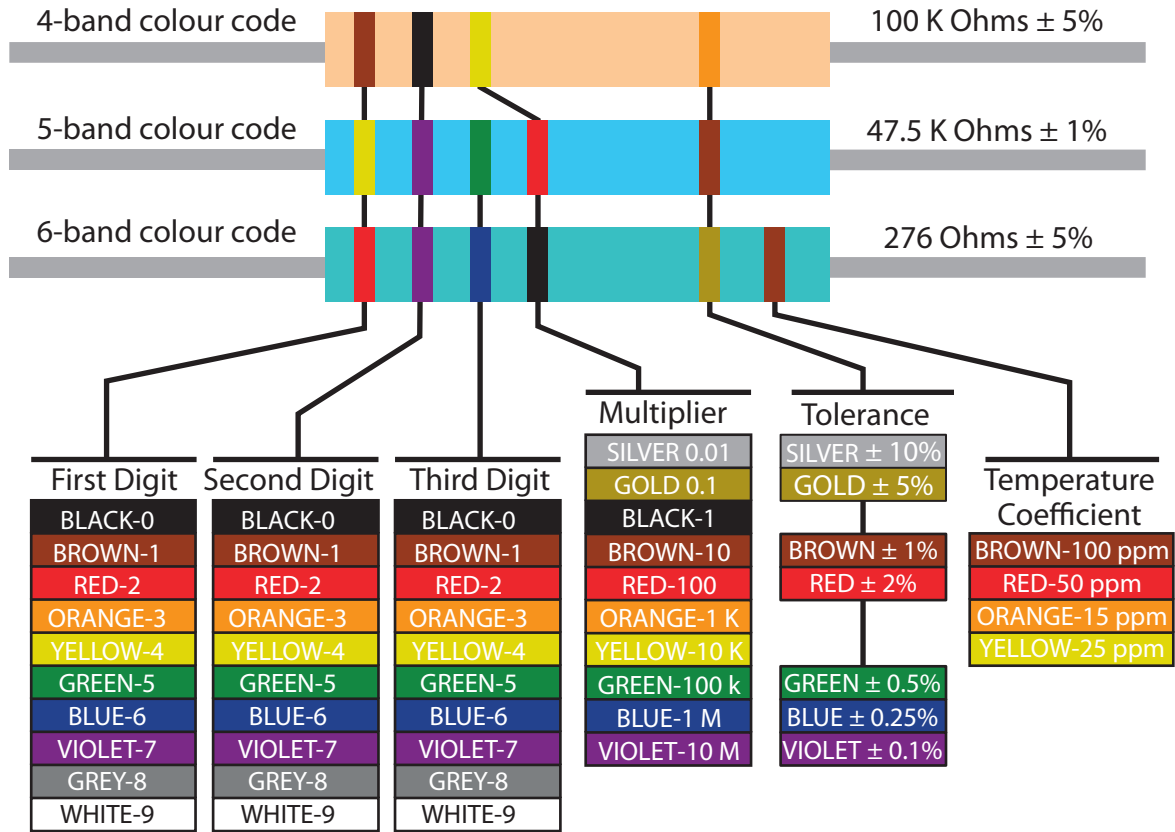
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## Resistor Colour Code



## Original Equipment Manufacturers' (OEM) Data Sheets

You can refer to data sheets for individual electronic devices, e.g. Liquid Crystal Display (LCD) screens and microcontroller connections, so that you can assemble your prototype solution in an appropriate way.

## Use of library code and access to a list of programming commands/instructions

Learners can use software library code as part of their solution to the task, as it is common industry practice when using low level programming languages.

For lower level programming languages, such as 'C', learners can also be given a list of common commands/instructions. The list must only cover the syntax of the commands/instructions. For example, the list may include: 'if (x<5){ } else { }'.

Learners **must not** have access to the internet during the task.

# Pearson BTEC Level 3 Nationals Extended Diploma

**Window for supervised period:**

**Monday 7 December 2020 – Wednesday 20 January 2021**

Controlled hours: 12 hours

Paper Reference **31725H**

## Engineering

**Unit 6: Microcontroller Systems for Engineers**

**Client Brief**

**Part S**

**You must have:**

Appropriate hardware (including electronic components), programming and word processing software, a calculator, audio-visual equipment and, if required, the Information Booklet.

### Instructions

- **Part S** should be undertaken in 12 hours under supervision over no more than 5 consecutive working days. The supervised sessions take place in the two-week period timetabled by Pearson.
- **Part S** contains material for the completion of the set task under supervised conditions.
- **Part S** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part S** should be kept securely until the start of the 12-hour supervised assessment period.
- Answer **all** activities in the Electronic Task Booklet provided and produce an audio-visual recording of the system in operation.

### Information

- The total mark for this task is 80.
- The marks for **each** activity are shown in brackets  
– use this as a guide as to how much time to spend on each activity.

### Advice

- Read each activity carefully before you start to answer it.
- Try to answer every activity.
- Check your answers if you have time at the end.

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## Instructions to Teachers/Tutors

This task must be read in conjunction with information on conduct for the task in the unit specification and the *BTEC Nationals Instructions for Conducting External Assessments (ICEA)* document. For further details please see the Pearson website.

The set task should be carried out under supervised conditions.

Work should be completed on a computer using appropriate hardware and software as listed in the unit content. Learners should complete the Electronic Task Booklet provided by Pearson. This can be downloaded from the Pearson website. Learners must not have access to the internet. One task booklet and one audio-visual recording must be submitted to Pearson on a USB memory stick or in exceptional circumstances a compact disc (CD) can be submitted instead.

Learners will need access to suitable audio-visual recording equipment and the footage should be recorded in an appropriate file format. The recording must be readable through one of the following software applications: Windows Movie, Real Time, VLC or Quick Time. You must save the recordings in one of the following file types: MPEG, FLV, MOV, WMV or RM.

Centres must make sure that all electronic documents are backed up securely and are kept until the end of the post-results service window.

All learner work must be completed independently and authenticated by the teacher/tutor and/or invigilator before being submitted to Pearson.

Centres are free to arrange the supervised assessment period how they wish provided the 12 hours for producing final outcomes are under the level of control specified, and in accordance with the conduct procedures. The assessment must take place in a two-week period set by Pearson, once the learner has started **Part S** the assessment must be completed in five consecutive working days.

If learners are to produce a solution to the task using individual electronic components and/or a prototyping board, they may need the **Part S** Information Booklet. Centres **can** also provide learners with Original Equipment Manufacturers' Data Sheets for individual electronic devices, e.g. Liquid Crystal Display (LCD) screens and humidity sensors, so that learners can assemble their prototype solution in an appropriate way, but the data sheets **must not** contain any other extraneous handwritten information on them.

Refer carefully to the instructions in this task booklet and the *BTEC Nationals Instructions for Conducting External Assessments (ICEA)* document to ensure that the assessment is supervised correctly. An authentication statement will be required confirming that learner work has been completed as directed.

Learners must not bring anything into the supervised environment or take anything out without teacher/tutor and/or invigilator knowledge and approval. Centres are responsible for putting in place appropriate checks to ensure that only permitted material is introduced into the supervised environment.

## Maintaining security

- For **Part S**, learners **must not** have access to the internet.
- During any break materials must be kept securely.
- User areas must only be accessible to the individual learners and to named members of staff.
- Learners can only access their work under supervision.
- Learner work must be backed up regularly.
- Any work learners produce under supervision must be kept secure.
- Any materials being used by learners must be labelled and collected in at the end of each session, stored securely and handed back at the beginning of the next session.

## Outcomes for submission

### Each learner will need to submit:

- (a) An Electronic Task Booklet (in PDF format), which contains the following evidence:
- task planning and system design changes made during the development process
  - a technical specification with operational requirements
  - a test plan
  - details and justifications of input/output devices and hardware selected
  - system connection diagrams/schematics
  - design of the program structure
  - annotated copy of all the code
  - test data and analysis.
- (b) An audio-visual file (recording) of maximum length of three minutes.

Each learner will need to submit evidence using the file names below:

- Electronic Task Booklet: booklet\_[Registration number #]\_[surname]\_[first letter of first name]
- Audio-visual file: file\_[Registration number #]\_[surname]\_[first letter of first name]

A fully completed authentication sheet must be completed by each learner.

The work should be submitted no later than 22 January 2021.

## Instructions for Learners

Read the set task information carefully.

This contains all the information you need to complete each activity in the set task.

You will be given more than one timetabled session to complete these tasks in controlled conditions.

You must plan your time accordingly and be prepared to submit all the required evidence by the date specified.

You will complete this set task under supervision and your work will be kept securely during any breaks taken.

You may use a calculator and will have access to a computer, but not the internet.

You must work independently throughout the supervised assessment period and you must not share your work with other learners.

Your teacher/tutor/invigilator may clarify the wording that appears in this task but cannot provide any guidance on how to complete the task. You may need to use the Information Booklet.

### Outcomes for submission

#### You will need to submit:

(a) An Electronic Task Booklet (in PDF format), that contains the following evidence:

- task planning and system design changes made during the development process
- technical specification with operational requirements
- test plan
- details and justifications of input/output devices and hardware selected
- system connection diagrams/schematics
- design of the program structure
- annotated copy of all the code
- test data and analysis.

(b) An audio-visual file (recording) of maximum length of three minutes.

Each learner will need to submit evidence using the file names below:

- Electronic Task Booklet: booklet\_[Registration number #]\_[surname]\_[first letter of first name]
- Audio-visual file: file\_[Registration number #]\_[surname]\_[first letter of first name]

A fully completed authentication sheet must be completed by each learner.

The work should be submitted no later than 22 January 2021.

## Set Task Brief

### Scenario

You are employed by an engineering company that designs control and monitoring systems to provide a solution to a problem for One90 Road Services.

You have been presented with a client brief to develop a prototype traffic light control system that can be used when a road is being repaired.

### Client brief

One90 Road Services needs to close one side of the road to traffic so that the repair work can be done safely. A temporary traffic light system is required to control the movement of vehicles safely through the roadworks. The traffic must be allowed to pass in one direction for the set time period before the traffic lights change, so that the traffic from the other side can pass through for the set time period.

The client has provided a plan drawing of the roadworks, as shown in Figure 1, with the traffic currently moving from right to left.

In Figure 1, traffic light Set A is on red and traffic light Set B is on green, which is Step 3 in the operational sequence in Figure 2.

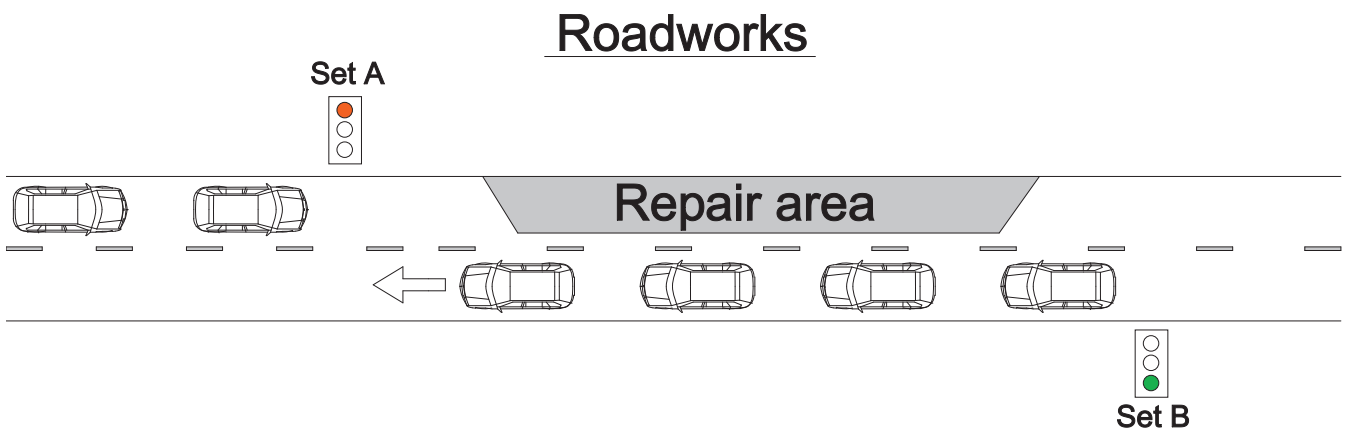
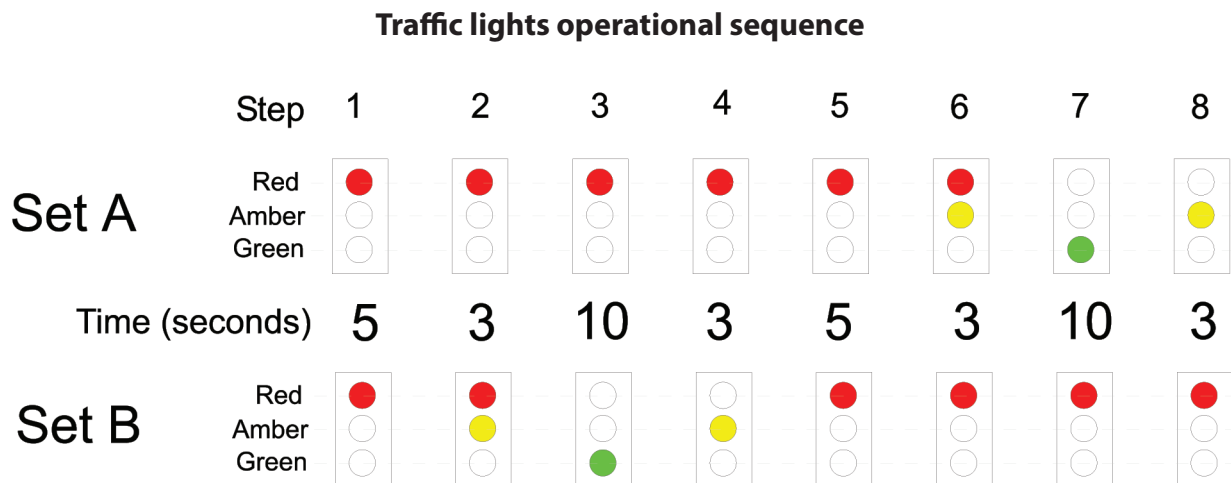


Figure 1



The client has also provided you with the operational sequence for the traffic lights in Figure 2.



**Figure 2**

To control the traffic, One90 Road Services has requested a prototype traffic light system that will, as a minimum:

- provide the correct operational sequence for the Set A traffic lights
- provide the correct operational sequence for the Set B traffic lights
- provide an option to override the operational sequence and change both sets of traffic lights to red, e.g. to stop all traffic on both sides of the roadworks when delivery vehicles need to enter or leave the repair area
- be able to safely restart the traffic light operational sequence, e.g. after the override has been triggered or at any other time.

In developing the prototype system, you should consider **enhanced user experiences** and how it would deal with any **unexpected events** that may occur.

**Notice**

The operation and testing of the prototype system does **not** require the use of:

- vehicles
- real traffic management equipment or sites.

The client has indicated that the actual traffic light system will use different timings, but they want you to comply with the operational sequence steps above for the prototype system.

You need to:

- produce a record of task planning and system design changes made during the development process
- interpret a brief into operational requirements
- design a test plan based on operational requirements
- select and describe appropriate input/output components and how they will work together
- design the program structure
- produce a functional system
- annotate a program or code to demonstrate understanding
- test the system and analyse the outcomes from testing
- produce an audio-visual recording of the system in operation of no longer than three minutes.

## Set Task

### Task

Design, assemble, program and test a safe prototype system to control the traffic through the roadworks that will meet the requirements of the client brief.

To control the traffic, One90 Road Services has requested a prototype traffic light system that will, as a minimum:

- provide the correct operational sequence for the Set A traffic lights
- provide the correct operational sequence for the Set B traffic lights
- provide an option to override the operational sequence and change both sets of traffic lights to red, e.g. to stop all traffic on both sides of the roadworks when delivery vehicles need to enter or leave the repair area
- be able to safely restart the traffic light operational sequence, e.g. after the override has been triggered or at any other time.

The client has **not** specified all the prototype system's functions and constraints. These other functions and constraints are for you, as the developer, to determine and justify. For example:

- the timings for the traffic light operational sequence as shown in Figure 2 are just recommendations
- the brightness of the traffic lights and how they are mounted has not been specified.

You must follow an appropriate development process and use a microcontroller.

In developing the prototype system, you should consider **enhanced user experiences** and how it would deal with any **unexpected events** that may occur.

You will have a total of 12 hours to complete your prototype system (including testing and documentation and audio-visual recording), which may be split in to several shorter sessions.

### Health and safety notice

Standard health and safety procedures **must** be followed at all times.

The operation and testing of the prototype system does **not** require the use of:

- vehicles
- real traffic management equipment or sites.

The stages below will help you to structure your development work.

### **Activity 1**

#### **Task planning and system design changes**

You are advised to spend no longer than 1.5 hours on this activity.

- At the start of the task, create a short project time plan/Gantt chart and use it to monitor your progress throughout the rest of the task and make any adjustments as required.
- During the other activities (2 to 5), you should also **record in the Activity 1 section** of your Electronic Task Booklet:
  - what you did in the session
  - details of any issues encountered and solutions discovered
  - action points for the next session.

**(Total for Activity 1 = 10 marks)**

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### **Activity 2**

#### **Analysis of the brief**

You are advised to spend no longer than 1.5 hours on this activity.

- By interpreting the client brief into operational requirements, prepare a technical specification for a user-friendly system that can handle some unexpected events.
- Prepare a test plan to check the functionality of the final solution against the technical specification and include some unexpected events.

**(Total for Activity 2 = 9 marks)**

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### **Activity 3**

#### **System design**

You are advised to spend no longer than 2.5 hours on this activity.

Prepare a user-friendly system design that can handle some unexpected events, including:

- the selection and justification of suitable input and output devices
- a description of the system design covering input and output devices and microcontroller connections
- a plan for the program structure detailing key system operations.

**(Total for Activity 3 = 16 marks)**

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#### **Activity 4**

##### **System assembly and programming**

You are advised to spend no longer than 2.5 hours on this activity.

Develop a user-friendly system that is well organised, structured and formatted, including:

- producing the software program and annotating the code
- the assembly of any hardware (if required)
- refining the system so that it operates as expected and can handle some unexpected events.

Once completed, insert the annotated code into the Electronic Task Booklet.

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**(Total for Activity 4 = 16 marks)**

#### **Activity 5**

##### **System testing and result analysis**

You are advised to spend no longer than 1.5 hours on this activity.

- Test the system using the test plan (from **Activity 2**) and include some unexpected events.
- Record the outcome of each test in the template provided.
- Analyse the test results and evaluate the system for conformance against the client brief.

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**(Total for Activity 5 = 9 marks)**

#### **Activity 6**

##### **System in operation**

You are advised to spend no longer than 2.5 hours on this activity.

Produce an audio-visual recording that demonstrates the system in operation, which should include:

- your name, learner registration number and centre number at the start
- a commentary explaining the operation of the user-friendly system and how its behaviour is linked with your chosen hardware and the software program
- recorded evidence of the outcome from suitable tests including some unexpected events (from **Activity 5**).

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**(Total for Activity 6 = 20 marks)**

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**TOTAL FOR TASK = 80 MARKS**

Candidate surname		Other names	
<input type="text"/>		<input type="text"/>	
Pearson BTEC Level 3 Nationals Extended Diploma	Centre Number	Learner Registration Number	
	<input type="text"/>	<input type="text"/>	
<b>Window for supervised period: Monday 7 December 2020 - Wednesday 20 January 2021</b>			
Controlled hours: 12 hours		Paper Reference <b>31725H</b>	
<b>Engineering</b> Unit 6: Microcontroller Systems for Engineers Electronic Task Booklet			<b>Part S</b>
<p><b>You must have:</b> Appropriate hardware (including electronic components), programming and word processing software, a calculator, audio-visual equipment and, if required, the Information Booklet.</p>			Total Marks

### Instructions

- Fill in the boxes at the top of this page with your name, centre number and learner registration number.
- Answer all activities in this Electronic Task Booklet and produce an audio-visual recording of the system in operation.
- Part S should be undertaken in 12 hours under supervision over no more than 5 consecutive working days. The supervised sessions take place in the 2-week period timetabled by Pearson.

### Information

- The total mark for this task is 80.
- The marks for each activity are shown in brackets
- use this as a guide as to how much time to spend on each activity.

### Advice

- Read each activity carefully before you start to answer it.
- Try to answer every activity.
- Check your answers if you have time at the end.

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**Complete your work in this Electronic Task Booklet.**

## **Activity 1**

### **Task planning and system design changes**

You are advised to spend no longer than 1.5 hours on this activity.

At the start of the task, create a short project time plan/Gantt chart and use it to monitor your progress throughout the rest of the task and make any adjustments as required.

During the other activities (2 to 5), you should also **record in the Activity 1 section** of your electronic task booklet:

- what you did in the session
- details of any issues encountered in this session and solutions discovered
- action points for the next session.

(10)

Initial Task Plan

**Instruction** - during each session, please complete the following logbook, duplicating the table as required for each session (cut and paste the table as required).

Remember to update the project time plan/Gantt chart at the start of each session.

Date:

What I have done this session:

Issues encountered this session and solutions with justification:

Action points for the next session:

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**(Total for Activity 1 = 10 marks)**



## Activity 2

### Analysis of the brief

You are advised to spend no longer than 1.5 hours on this activity.

- By interpreting the client brief into operational requirements, prepare a technical specification for a user-friendly system that can handle some unexpected events.
- Prepare a test plan to check the functionality of the final solution against the technical specification and include some unexpected events.

(9)

**Test Plan Template (Activity 2)**

Tests can include unexpected events (i.e. non-routine) that are outside the normal operation of the system.

Test number	Purpose of test	Test condition	Expected result

**(Total for Activity 2= 9 marks)**

### **Activity 3**

#### **System design**

You are advised to spend no longer than 2.5 hours on this activity.

Prepare a user-friendly system design that can handle some unexpected events, including:

- the selection and justification of suitable input and output devices
- a description of the system design covering input and output devices and microcontroller connections
- a plan for the program structure detailing key system operations.

For **Activity 3** you could provide: written notes, annotated diagrams, flow charts, images, schematics, pseudocode and tables.

(16)

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**(Total for Activity 3 = 16 marks)**

## Activity 4

### System assembly and programming

You are advised to spend no longer than 2.5 hours on this activity.

Develop a user-friendly system that is well organised, structured and formatted, including:

- producing the software program and annotating the code
- the assembly of any hardware (if required)
- refining the system so that it operates as expected and can handle some unexpected events.

Once completed insert the annotated code into the electronic task booklet.

For **Activity 4** you could provide: written notes, screenshots, annotated programs/flow charts and images.

(16)

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**(Total for Activity 4 = 16 marks)**

## Activity 5

### System testing and results analysis

You are advised to spend no longer than 1.5 hours on this activity.

- Test the system using the test plan (from **Activity 2**) and include some unexpected events.
- Record the outcome of each test in the template provided.
- Analyse the test results and evaluate the system for conformance against the client brief.

(9)

### Test Plan Template (Activity 5)

Tests can include unexpected events (i.e. non-routine) that are outside the normal operation of the system.

Copy and paste your test plan from Activity 2 into the table below and complete the Activity 5 columns.

Activity 2				Activity 5	
Test number	Purpose of test	Test condition	Expected result	Actual result	Comments and justification

(Total for Activity 5 = 9 marks)

## Activity 6

### System in operation

You are advised to spend no longer than 2.5 hours on this activity.

Produce an audio-visual recording that demonstrates the system in operation, which should include:

- your name, learner registration number and centre number at the start
- a commentary explaining the operation of the user-friendly system and how its behaviour is linked with your chosen hardware and software program
- recorded evidence of the outcome from suitable tests including some unexpected events (from **Activity 5**).

Please note that the evidence for this activity should be in a separate audio-visual recording of no more than three minutes.

Do not add any comments for Activity 6 into this electronic task booklet.

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**(Total for Activity 6 = 20 marks)**

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**TOTAL FOR TASK = 80 MARKS**