

Write your name here

Surname	Other names
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**Pearson BTEC
L3 Nationals
Extended
Diploma**

Centre Number

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Learner Registration Number

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Engineering

Unit 6: Microcontroller Systems for Engineers

Part S

Window for supervised period:
23 April 2018 – 4 May 2018
Controlled hours: 12 hours

Paper Reference
31725H

You must have:

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

Total Marks

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Instructions

- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- **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.
- Answer the activities in the spaces provided.

Information

- The total mark for this paper 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 question.

Advice

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

Turn over ►

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Instructions to Teachers/Tutors

This paper 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 a compact disc (CD) for each learner.

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 is 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 5 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 hand written information on them.

Refer carefully to the instructions in this task booklet and the 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 your knowledge and approval. Centres are responsible for putting in place appropriate checks to ensure that only permitted material is introduced into the supervised environment.

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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 learner 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 period, stored securely and handed back at the beginning of the next period.

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 15 May 2018.



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 period 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 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, which 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), 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 15 May 2018.



Set Task Brief

Scenario

You are employed by an engineering company that designs monitoring systems to provide a solution to a problem for a national supermarket chain.

You have been presented with a client brief to develop a door monitoring system for the refrigerated area within its stores.

Client brief

Throughout the day, supermarket employees need access to the refrigerated area to collect frozen foods, which need to be stacked securely onto a trolley so they can be transported throughout the supermarket. There are often problems when stacking the trollies and this has meant delays in closing the large doors, as employees get preoccupied or forget to close them.

The refrigerated area is used 24 hours a day, seven days a week, and the large doors are opened over 200 times a day. Leaving the doors open for longer than necessary means energy is wasted and costs will rise.

To overcome the problem, the client would like:

- at least two different indicators to show that the doors are open
- a safe system to monitor the time the doors are open
- the indicators to become more noticeable the longer the doors are left open.

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 the program or code
- 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

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Set task

Task

Design, assemble, program and test a safe prototype system to monitor the time that the refrigerated doors are open/closed that meets the requirements of the client brief.

To overcome the problem, the client would like:

- at least two different indicators to show that the doors are open
- a safe system to monitor the time the doors are open
- the indicators to become more noticeable the longer the doors are left open.

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

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

The operation and testing of the prototype system does not require physical access to a refrigerated area. Also, the measurement of temperature and prototype doors are not required for this task.

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)

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)



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)

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.

(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.

(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).

(Total for Activity 6 = 20 marks)

TOTAL FOR TASK = 80 MARKS

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Complete your work in this task booklet.

Activity 1

Task Planning and system design changes

- 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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Activity 2

Analysis of the brief

- 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



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Activity 3

System design

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)



Activity 4

System assembly and programming

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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Activity 5

System testing and results analysis

- 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



Activity 6

System in operation

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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