

ENGINEERING PROGRAMMABLE SYSTEMS

Examiners' report

INCLUDED ON THE
KS4 PERFORMANCE TABLES

OCR Level 1/Level 2

Cambridge National in Engineering Programmable Systems

J824

For first teaching in 2022 | Version 1

R047 January 2024 series

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from [Teach Cambridge](#).

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R047 series overview

This component of the Programmable Systems qualification consists of two sections: Section A and Section B.

Section A consists of ten multiple choice questions, with each having one correct answer and three distractors.

Section B of the paper consists of six questions, which are designed to test candidate's knowledge of the wider specification and their ability to respond to key command words.

To do well in this paper, candidates need to have a good understanding of circuit components and their uses, as well as the design, development and manufacture of printed circuit boards, using various methods and technologies.

A proportion of candidates attempted all 16 questions, but their knowledge of some sections of the specification appeared to be limited in a number of cases. This was confirmed by the number of questions to which no response was given. Candidates should be advised to attempt all questions.

It was good to note that a proportion of candidates obtained high marks by carrying out calculations correctly, ensuring that all stages of workings were shown.

The mandatory NEA components (R048 and R049) allow candidates to apply some of the knowledge that they will need to recall in R047, as well as doing it in a more practical manner.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> analysed scenarios, leading to selection of suitable circuit components, with justification for choice produced clear and well-balanced responses for the Level of Response question performed accurate calculations, showing clear workings accurately applied knowledge of command words to respond to questions set. 	<ul style="list-style-type: none"> found it difficult to select specific circuit components, especially in unfamiliar situations produced responses to the Level of Response question that lacked depth and understanding of the question set were unable to use justification to support responses showed limited knowledge of key formulae and their application.

OCR support



Further guidance, support and resources for delivering this component can be found on the subject page on [Teach Cambridge](#).

Section A overview

Section A consists of ten multiple choice questions, with each having one correct answer and three distractors. Candidates should be advised to read all available options carefully before selecting an appropriate answer.

Question 1

- 1 What is the correct name for a type of printed circuit board (PCB) that can be bent into different shapes?

(a) Double sided

(b) Flexible

(c) Single sided

(d) Strip board

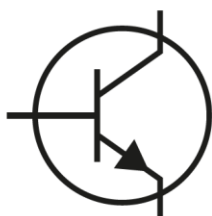
☐
☐
☐
☐

[1]

The majority of candidates correctly identified 'Flexible' as the correct response. 'Strip board' was chosen by some and acted as a distractor.

Question 2

- 2 What component does this circuit symbol represent?



(a) NPN transistor

(b) NTC thermistor

(c) QTC switch

(d) SPST switch

☐
☐
☐
☐

[1]

Generally well-answered by candidates, selecting 'NPN transistor'. A number of candidates chose the distractor of 'NTC thermistor'.

Question 3

3 Which of these types of logic gate only produces a high output signal when both inputs are high?

(a) AND

☐

(b) NAND

☐

(c) NOT

☐

(d) OR

☐

[1]

The majority of candidates correctly chose 'AND', with very few selecting the three distractors.

Question 4

4 Which of these types of diagram uses circuit symbols to represent individual components?

(a) Block diagram

☐

(b) Printed circuit board (PCB) layout

☐

(c) Schematic

☐

(d) Systems diagram

☐

[1]

Candidates who did well on this question correctly identified 'Schematic' as the correct response. A proportion of candidates chose the distractor of 'Systems diagram'.

Question 5

- 5** You have been asked to measure the characteristics of waveforms outputted from an amplifier circuit.

Which of these items of test equipment is best suited to this task?

(a) Continuity tester

☐

(b) Logic probe

☐

(c) Oscilloscope

☐

(d) Signal generator

☐

[1]

Many candidates were able to correctly identify the 'Oscilloscope' as the correct response.

Question 6

- 6** Which of these components is best described as only allowing current to flow in one direction?

(a) Capacitor

☐

(b) Diode

☐

(c) Fixed resistor

☐

(d) Variable resistor

☐

[1]

Successful responses to this question identified 'Diode' as the correct answer. 'Fixed resistor' on many occasions was incorrectly identified as the correct component.

Question 7

7 Which of these is a unit multiple?

(a) Kilo

☐

(b) Milli

☐

(c) Nano

☐

(d) Pico

☐

[1]

Generally well-answered by the candidates, selecting 'Kilo' as the correct response.

Some candidates showed limited understanding of the difference between multiple and submultiple.

Question 8

8 What type of charge carriers are electrons?

(a) Alternating

☐

(b) Negative

☐

(c) Neutral

☐

(d) Positive

☐

[1]

The majority of candidates correctly identified 'Negative' as the type of charge.

Some candidates selected 'Positive', showing some confusion with the polarity of a battery.

Question 9

9 What is solid core wire also known as?

(a) Flexible

☐

(b) Multi-strand

☐

(c) Polarised

☐

(d) Single-strand

☐

[1]

The majority of responses identified 'Single-strand' as the correct answer.

Question 10

10 A house alarm stays on, once activated, until a reset button is pressed.

Which of these types of process device would be the **most** appropriate for this application?

(a) Amplifier

☐

(b) Counter

☐

(c) Latch

☐

(d) Timer

☐

[1]

A proportion of candidates were able to identify the correct process device, with a large number selecting one of the three distractors.

Section B overview

Section B of the paper consists of six questions, which are designed to test candidates' knowledge of the wider specification and their ability to respond to key command words.

Assessment for learning



A good technique for centres to adopt would be for their candidates to be able to deconstruct the questions, paying particular attention to **command words**, as well as being able to identify **key words** within the question.

Question 11 (a) (i)

11 You are developing a programmable system for a car park barrier.

The system must detect when a car has arrived at the barrier. The barrier will then lift so that the car can drive into the car park. A visual indicator will also inform the driver that it is safe to enter.

(a)

(i) Identify **two** input components that could be used to detect when a car has arrived in front of the barrier.

For **each** input component, give a reason why it is suitable for this application.

1

Why suitable

.....

2

Why suitable

.....

[4]

Few candidates were able to correctly identify two input components. The majority of candidates gave vague responses such as 'light sensor' instead of a component such as an LDR.

Candidates who did less well on this question were unable to give valid reasons why each component was suitable, showing limited component knowledge.

Question 11 (a) (ii)

(ii) Identify **one** output device that could be used to lift the barrier.

..... [1]

The majority of candidates gave the correct answer of 'Motor'.

Question 11 (a) (iii)

(iii) Identify **one** output device that could be used to indicate to the driver that it is safe to enter the car park.

..... [1]

Candidates had very good knowledge of output devices that were suitable as a visual indicator, with the majority selecting LED.

Assessment for learning



Candidates should be advised to practice applying knowledge of components to various scenarios, supported by justification for component choice.

Question 11 (b)

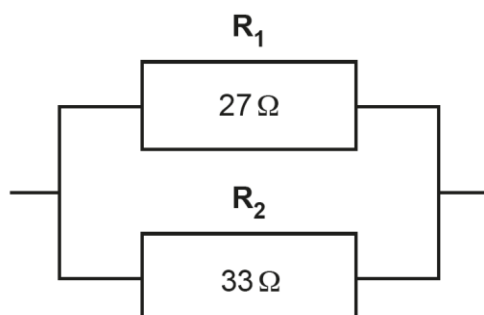
(b) The system is to be commercially produced for use on several different car park barriers. The circuitry will be assembled using surface mount technology (SMT).

Evaluate the use of SMT to assemble the circuit.

.....
.....
.....
.....
.....
..... [4]

Successful responses to this question showed a clear understanding of the SMT process and how it could be used to aid the production of car park barriers.

A proportion of candidates were unfamiliar with command word '**evaluate**', instead describing the SMT process.

Question 12 (a)**12****(a)** A parallel resistor arrangement is shown below.

Calculate the total resistance of the resistor arrangement.

Give your answer in ohms. Show all your working.

Total resistance Ω **[4]**

Candidates who did well on this question were able to recall the correct formula and apply this to gain the total resistance.

A number of candidates attempted the calculation using the formula for the calculation of series resistors, resulting in an incorrect response.

Question 12 (b)

(b) An electronic circuit is rated at 9V and 12A.

Calculate the power rating of the circuit.

Give your answer using the correct unit. Show all your working.

Power rating Unit **[4]**

A generally well-answered question, with a high proportion of candidates being able to recall Watt's law, and correctly apply it to the circuit values given.

Question 13 (a)

13

(a) Describe how printed circuit boards (PCBs) are produced using CAM milling/routing.

.....

.....

.....

.....

.....

..... [5]

Successful responses to this question were able to describe the key stages of using CAM milling/routing to make a PCB.

The majority of candidates were able to recall some key stages but showed limited understanding of the full process.

It is suggested that where equipment is unavailable, candidates might benefit from YouTube clips to demonstrate the process.

Question 13 (b)

- (b)** Discuss the advantages and disadvantages of using photo etching to produce printed circuit boards (PCBs).

.....

.....

.....

.....

.....

..... [6]

Candidates who did well on this question were able to give a balanced discussion, with at least two advantages and disadvantages of the photo etching process, supported by good use of technical terms.

Many candidates were able to describe the hazards involved in the process, with most discussions focussing on the negative aspects.

Question 14 (a) (i)

14

(a)

- (i)** Describe what is meant by a 'PLC' in an electronic system.

.....

.....

.....

..... [2]

A proportion of candidates were able to gain 1 mark for identifying a PLC as being a Programmable Logic Controller. Few candidates were then able to describe what exactly a PLC does.

A large proportion of no response were seen here.

Question 14 (a) (ii)

(ii) Identify **three** applications of PLCs.

- 1
- 2
- 3
- [3]

This question was generally given low marks. The industrial applications of PLCs were less well known.

Question 14 (b)

(b) Explain **one** advantage and **one** disadvantage of using flowchart systems instead of text-based languages when programming microcontrollers.

- Advantage
- Disadvantage
- [4]

Many candidates clearly had experience of using flowcharts and text-based languages.

A high proportion of candidates were able to identify an advantage and disadvantage. The majority of candidates did not go on to '**explain**', for them to be given 2 marks for each response.

Question 15 (a) (i)

- 15** You are designing a circuit for an electronic doorbell. The doorbell will be placed outside the front entrance to a building. When a button is pressed, a sound will alert people inside the building that somebody is at the door.

(a)

- (i)** Identify **two** sustainability issues that could be caused by the use of batteries to power the doorbell.

1

.....

2

.....

[2]

A proportion of candidates were able to gain 1 mark, correctly identifying a sustainable issue. A large number of candidates incorrectly gave comments linked to the frequency of replacement.

Question 15 (a) (ii)

- (ii)** Explain **one** advantage and **one** disadvantage of using a photovoltaic cell as the power supply for the doorbell.

Advantage

.....

.....

.....

Disadvantage

.....

.....

.....

[4]

Successful responses to this question were able to explain an advantage and disadvantage of photovoltaic cells as a power source. Less successful responses 'listed' instead of 'explaining'.

OCR support

Candidates could be directed to the OCR command words guidance on page 9 of [Understanding the assessment: examined and moderated](#).

Question 15 (b) (i)**(b)****(i)** Explain **two** advantages of using CAD software to produce a model of the doorbell circuit.

1

.....

.....

.....

2

.....

.....

.....

[4]

The majority of responses showed awareness of CAD software and it was clear that most candidates had experience of using it. A small number of candidates gave responses linked to modelling a case, instead of the circuit itself.

Question 15 (b) (ii)

- (ii) Other than making a printed circuit board (PCB), identify **three** methods that could be used to produce a physical prototype of the circuit for the doorbell.

1

.....

2

.....

3

.....

[3]

Generally well-answered, with the majority of candidates being able to correctly identify two physical prototyping methods. Most candidates had an awareness of the use of breadboards to prototype circuits.

OCR support



Candidates should be guided to the OCR [specification](#) for this component, where a list of prototyping methods can be found on page 18.

Question 16 (a)

16

- (a) Complete the table below by filling in the missing definitions and their SI units of measurement.

Term	Definition	SI unit of measurement
Capacitance		
Frequency		
Potential difference	The difference in the amount of energy that charge carriers have between two points in a circuit.	

[5]

A number of candidates were able to correctly identify the SI units for each term given.

A small number of candidates were able to accurately define capacitance and frequency.

Question 16 (b)

(b) Identify **two** characteristics of digital signals.

- 1
-
- 2
-

[2]

Generally well-answered by the majority of candidates, being able to identify two characteristics.

Most candidates linked responses to the use of 1's and 0's, and the square wave form.

Question 16 (c)

(c) Describe the difference between alternating current (AC) and direct current (DC).

-
-
-
- [2]

The majority of candidates were able to describe the difference between AC and DC.

Less successful responses only described one or the other.

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