



Oxford Cambridge and RSA

**Thursday 11 January 2024 – Afternoon**

**Level 1/Level 2 Cambridge National in Engineering  
Programmable Systems**

**R047/01 Principles of electronic and programmable systems**

**Time allowed: 1 hour 15 minutes**

**You can use:**

- a calculator



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

### INSTRUCTIONS

- Use black ink.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question number.
- Answer **all** the questions.

### INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [ ].
- This document has **12** pages.

### ADVICE

- Read each question carefully before you start your answer.

## Section A

Put a tick (✓) in the box next to the **one** correct answer for each question.

- 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

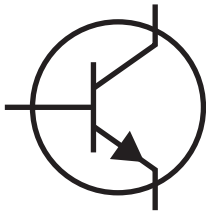
☐

(d) Strip board

☐

[1]

- 2 What component does this circuit symbol represent?



(a) NPN transistor

☐

(b) NTC thermistor

☐

(c) QTC switch

☐

(d) SPST switch

☐

[1]

- 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]

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]

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]

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]

7 Which of these is a unit multiple?

(a) Kilo

☐

(b) Milli

☐

(c) Nano

☐

(d) Pico

☐

[1]

8 What type of charge carriers are electrons?

(a) Alternating

☐

(b) Negative

☐

(c) Neutral

☐

(d) Positive

☐

[1]

9 What is solid core wire also known as?

(a) Flexible

☐

(b) Multi-strand

☐

(c) Polarised

☐

(d) Single-strand

☐

[1]

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]

## Section B

- 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]**

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

..... **[1]**

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

..... **[1]**

- (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.

.....

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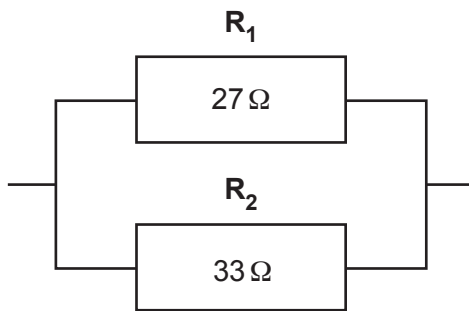
.....

.....

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

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 .....  $\Omega$  [4]

(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]

13

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

[5]

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

[6

14

(a)

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

.....

.....

.....

..... [2]

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

1 .....

.....

2 .....

.....

3 .....

..... [3]

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

Advantage .....

.....

.....

.....

Disadvantage .....

.....

.....

..... [4]



- 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]**

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

Advantage .....

.....

.....

.....

Disadvantage .....

.....

.....

.....

**[4]**

(b)

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

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(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]

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]

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

1 .....

.....

2 .....

.....

[2]

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

.....

.....

.....

..... [2]

**END OF QUESTION PAPER**

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