OCR
Oxford Cambridge and RSA

Thursday 12 June 2025 – 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

1923205051

You can use:
- a calculator

R047/01

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

Centre number | | | | | | Candidate number | | | | |

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 numbers.
- 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 **16** 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 Which of these describes a **smart sensor**?

(a) A sensor that has a built-in screen ☐

(b) A sensor that has WiFi capability ☐

(c) A sensor that must be wired into a circuit ☐

(d) A sensor that requires an additional power source ☐

[1]

2 Which of these unit submultiples means divide the value by 1000?

(a) Micro ☐

(b) Milli ☐

(c) Nano ☐

(d) Pico ☐

[1]

3 Which of these process devices adds up the number of input signals that it receives?

(a) Amplifier ☐

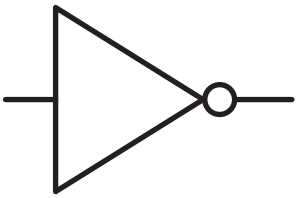
(b) Counter ☐

(c) Latch ☐

(d) Timer ☐

[1]

4 What logic gate does this circuit symbol represent?



(a) AND ☐

(b) NAND ☐

(c) NOT ☐

(d) OR ☐

[1]

5 Which of these is an advantage of using block-based programming editors?

(a) Code is inputted as a series of 1s and 0s ☐

(b) Does not require knowledge of actual programming code ☐

(c) Offers maximum programming functionality ☐

(d) Uses standard symbols and arrows to show program flow ☐

[1]

6 Which of these describes photo etching?

(a) A PCB production process where a CNC tool is used to remove excess copper ☐

(b) A PCB production process where chemicals are used to remove excess copper ☐

(c) A PCB assembly process where components are attached using solder paste ☐

(d) A PCB assembly process where components are manually soldered in place ☐

[1]

7 Which of these circuit prototyping methods involves physically placing components in rows of holes, without any soldering?

(a) Breadboarding ☐

(b) CAD modelling ☐

(c) Making a PCB ☐

(d) Stripboarding ☐

[1]

8 Which of these resistor types has a resistance value that changes when a screw fitting or knob is turned?

(a) Fixed ☐

(b) Light dependent ☐

(c) Temperature dependent ☐

(d) Variable ☐

[1]

9 Which of these is the correct formula for Watt's Law?

(a) $P = I^2V$ ☐

(b) $P = IV$ ☐

(c) $P = IV^2$ ☐

(d) $P^2 = IV$ ☐

[1]

10 Which of these display screen types could be used as an input device for a railway ticket machine?

(a) Backlit with a lamp ☐

(b) Liquid crystal display ☐

(c) Plasma display ☐

(d) Touchscreen ☐

[1]

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Section B

11 You are developing a safety light system to make people more visible when walking at night.

The system must produce a flashing light when manually turned 'on' by the user.

(a)

(i) Identify **two input** devices that could be used to manually turn the flashing light on.

State how **each input** device would function to achieve this outcome.

Input device 1 .....

How it functions .....

.....

[2]

Input device 2 .....

How it functions .....

.....

[2]

(ii) Identify **one non-programmable** process device that would be capable of producing the signals to flash the light.

State how the process device would function to achieve this outcome.

Process device .....

How it functions .....

.....

[2]

(b) A light emitting diode (LED) is to be used as the output device for the safety light system.

Evaluate the suitability of an LED for this application.

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.....

.....

.....

.....

.....

.....

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

12

(a) What are each of these electronic circuit parameters?

(i) Power

.....

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

(ii) Potential difference

.....

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

(iii) Frequency

.....

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

(b)

(i) A 12 Ω, 33 Ω and a 180 Ω resistor are connected in a series arrangement.

Calculate the total resistance of this arrangement.

Give your answer in ohms.

Show all your working.

Total resistance = ... Ω **[3]**

(ii) The resistor arrangement described in **(b)(i)** is connected to a 5 V battery.

Calculate the current flowing through the arrangement.

Give your answer using the correct unit.

Show all your working.

Current = ... Unit = ... **[4]**

13

(a) State **two** advantages and **two** disadvantages of using flow soldering to assemble circuits.

Advantage 1 .....

.....

Advantage 2 .....

.....

Disadvantage 1 .....

.....

Disadvantage 2 .....

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

(b) Discuss the reasons why **pick and place assembly** is used to construct commercial circuits.

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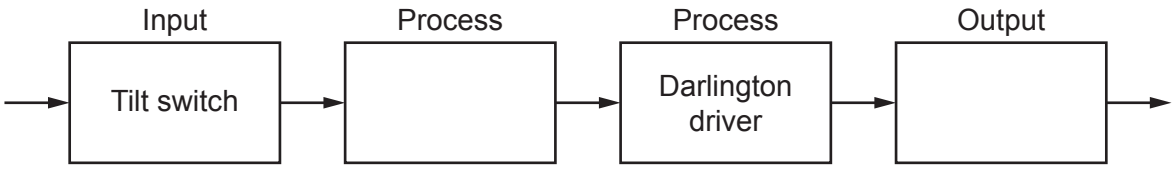
..... **[6]**

14 You are designing a system that can detect and make a sound when an object is tilting at an angle.

An incomplete block diagram for the system is shown below.

(a) Complete the block diagram by adding a **buzzer** and a **microcontroller** into the correct blocks.



[2]

(b) Describe the purpose of the arrows in the block diagram in **(a)**.

.....

.....

.....

..... **[2]**

(c) Explain the function of the **Darlington driver** within the system.

.....

.....

.....

..... **[2]**

(d) Explain **two** advantages of using a microcontroller in this system.

1 .....

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.....

.....

2 .....

.....

.....

.....

[4]

15

(a) State **one** use of a capacitor within a circuit.

.....

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

(b) Explain the difference between a polarised capacitor and a non-polarised capacitor.

.....

.....

.....

..... **[2]**

(c)

(i) State **three** applications of supercapacitors when they are used as power supplies.

1 .....

.....

2 .....

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3 .....

.....

[3]

(ii) Explain **two** reasons why supercapacitors are more sustainable power supplies than batteries.

1 .....

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2 .....

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.....

.....

[4]

16

(a) State **three** safety precautions that should be taken when using a logic probe to test the functionality of a circuit.

1 .....

.....

2 .....

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3 .....

.....

[3]

(b) Describe **five** steps that should be followed when using a signal generator to test a circuit.

Step 1 .....

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Step 2 .....

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Step 3 .....

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Step 4 .....

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Step 5 .....

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[5]

(c) Explain **one** characteristic of flexible PCBs.

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..... **[2]**

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