

**CAMBRIDGE NATIONALS**

**Examiners' report**

# **SYSTEMS CONTROL IN ENGINEERING**

**J833, J843**

**R113 Summer 2022 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. A selection of candidate answers is also provided. 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 OCR.

### Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our [website](#).

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## R113 series overview

Some candidates attempted all six questions but their knowledge of some sections of the specification appeared to be quite limited in a number of cases. This was confirmed by a significant increase in the number of questions to which no response was given. The standard of presentation and handwriting was sometimes poor, making some responses difficult to follow.

It was good to note that a proportion of candidates obtained high marks by carrying out calculations correctly by following the rubric, including taking care when dealing with units.

In a number of cases it was apparent that candidates had not read questions carefully enough before giving their answers, resulting in a loss of marks. In questions where candidates were asked to describe or explain functions and applications of components, it should be noted that justified responses needed to be presented in order to gain the higher marks available. One-word or overly simplistic responses are not suitable responses to this type of question: they limit candidates' ability to access the full range of marks available. However, it was good to note that a proportion of candidates obtained high marks by giving logical, clear responses to questions that involved terms such as 'describe' and 'explain'.

Other candidates had not read the question fully and went on to provide a response that was not relevant to the question. Candidates should be advised to read the complete question before providing a response.

In some responses to questions relating to basic electronic principles, candidates seemed to have guessed their responses, in order to provide any sort of an answer.

Some candidates were able to obtain high marks by recalling and drawing graphical symbols and recognising graphical symbols in questions. Many completed tables with correct labels.

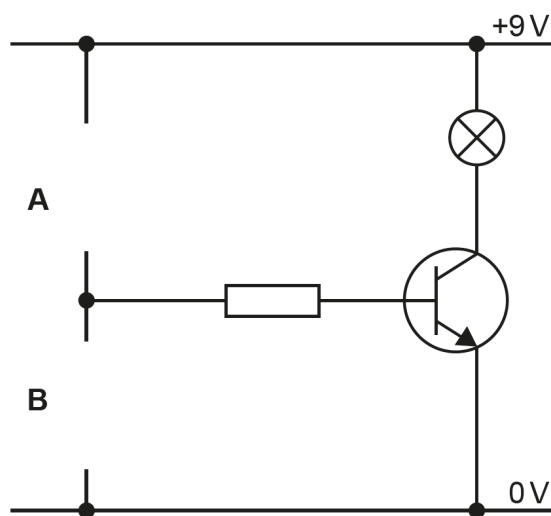
Candidates should be advised not to use the additional lined space unless absolutely necessary because sufficient space for an answer has been provided on the examination paper.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
<ul style="list-style-type: none"> <li>• performed standard calculations following the given rubric</li> <li>• produced clear and concise responses for Level of Response questions</li> <li>• completed circuit diagrams placing a variable resistor and a light dependent resistor in correct positions</li> <li>• applied knowledge and understanding to questions set in a novel context</li> <li>• completed tables with accuracy.</li> </ul>	<ul style="list-style-type: none"> <li>• found it difficult to apply what they had learned to unfamiliar situations</li> <li>• produced responses that lacked depth, and were often peripheral to what had been asked, sometimes simply repeating information provided</li> <li>• showed poor setting out of unstructured calculations</li> <li>• produced diagrams and completed circuits that had little or no meaning</li> <li>• were unable to complete tables with any degree of accuracy.</li> </ul>

### Question 1 (a)

1 Fig. 1 shows an incomplete circuit diagram.

Fig. 1



(a) Complete the circuit diagram in Fig. 1 by adding the following:

- a variable resistor at position A
- a light dependent resistor (LDR) at position B.

[2]

Candidates who did well on this question completed the circuit diagram accurately, using the correct symbols for a variable resistor and a light dependent resistor, and placed them in the correct positions. A small number of candidates used the correct symbols in the incorrect positions. Less successful responses produced incorrect symbols and incorrect positioning.

### Question 1 (b)

(b) Complete the table below by naming each of the components.

Component symbol	Name

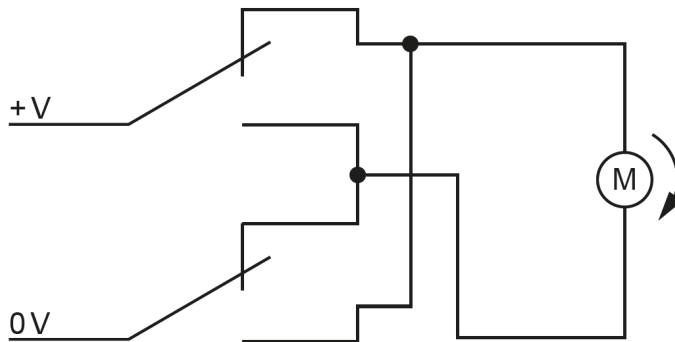
[3]

Candidates who did well on this question completed the table correctly using fuse, capacitor and diode. A small number of candidates named the fuse as a resistor. The capacitor on many occasions was incorrectly identified as a cell. The majority of candidates identified the diode correctly.

### Question 1 (c)

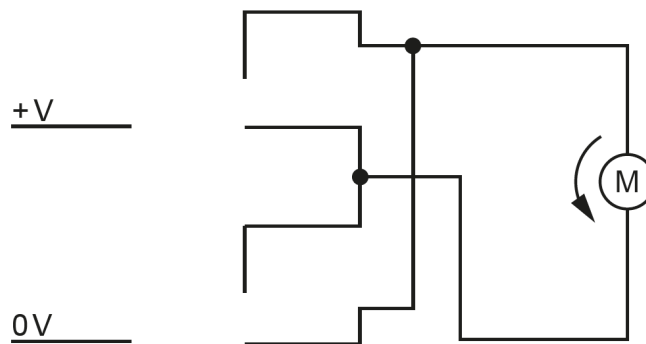
(c) Fig. 2 shows a motor connected to turn in a clockwise direction of rotation.

Fig. 2



Complete Fig. 3 to show the motor running in the reverse direction.

Fig. 3



[2]

The majority of candidates were able to correctly draw the switch positions showing the motor running in the reverse direction.

### Question 1 (d)

(d) Explain what is meant by the term 'rating of resistors'.

.....

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.....

.....

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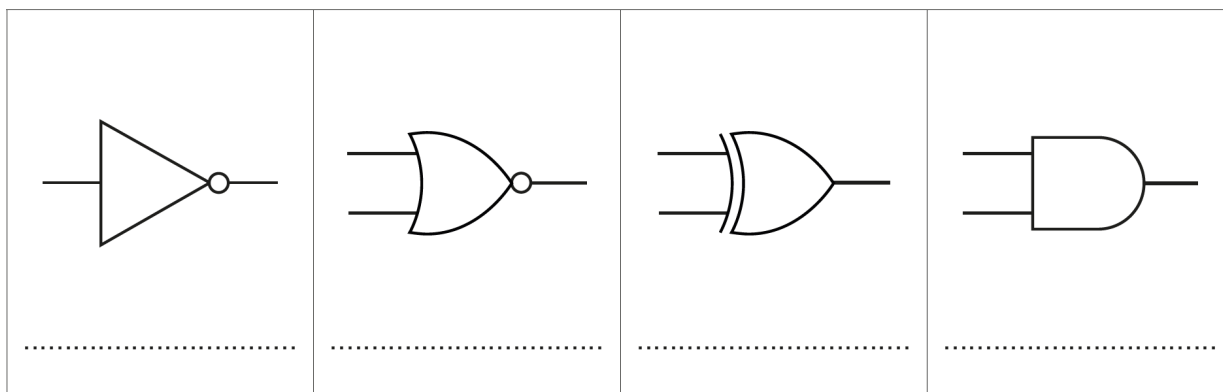
..... [3]

The majority of responses did not connect their answer to the rating of a resistor. Candidates appeared to lack knowledge which restricted the content of the answer provided. A few candidates stated that the power rating of a resistor is the term given to a resistor to describe the maximum amount of power that the resistor can withstand.

### Question 2 (a)

2 (a) Name each type of logic gate shown in Fig. 4.

Fig. 4



[4]

Generally well answered by the majority of candidates. The least well known logic gate was the NOT gate.

### Question 2 (b)

(b) Fig. 5 shows three signals that are part of the operation of a bistable circuit.

State the purpose of each signal in the operation of the bistable.

Fig. 5



[3]

The majority of responses had little to do with signals that are part of the operation of a bistable circuit. This question exposed some candidates' lack of knowledge and their responses were less successful. Very few gave a correct response of trigger or set input, reset input and output. The most common correct response was output.

### Question 2 (c)

(c) The time constant (**T**) in a monostable circuit is given by  $T = 1.1 RC$ .

**T** is in seconds, **R** is in ohms and **C** is in farads.

Calculate the time constant (**T**) in seconds when **R** = 50 kΩ and **C** = 10 μF.

.....

.....

.....

..... [3]

There was a mixed response to this question. Most candidates were able to convert the resistor value into ohms. Some were able to convert the capacitor value into farads. Some candidates incorrectly copied the formula, missing out the '1.1x' element.



### Question 3 (a)

3 A multimeter is set to measure resistance.

(a) Describe how you would use the multimeter to test whether a resistor is in good working order or is faulty.

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

A popular question with a few candidates obtaining good marks but a large number of candidates were confused between continuity and resistance testing. It seemed that candidates had performed continuity tests in centres, but had not used a multimeter to test whether or not a resistor is in good working order or is faulty. Correct responses did mention switching on and setting the dial to resistance and using the probes but after which the responses lacked depth and focus.

### Question 3 (b)

(b) Explain how a residual current device (RCD) operates.

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

Few candidates produced responses to do with the operation of a residual current device. The majority of responses lacked knowledge and gave little or no more information. Very few candidates understood that a residual current device operates and protects by constantly monitoring the current flowing in the active and neutral wires supplying equipment or circuits.

**Question 3 (c)**

(c) Fig. 6 shows two different types of cable used in electronics.

Name each type of cable.

**Fig. 6**



Cable A .....

Cable B .....

[2]

Generally well answered with the ribbon cable being better known than the multi-core cable.

**Question 4 (a) (i)**

4 (a) Automatic testing of commercially produced printed circuit boards (PCBs) for quality assurance can be carried out using optical equipment.

(i) Describe what happens during such an automatic test.

.....

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.....

[4]

The majority of responses had very little to do with the description of an automatic test. Few candidates described that the test involved a series of high powered cameras to look at the printed circuit board.

Question 4 (a) (ii)

(ii) State **two** types of fault that a technician might find when visually inspecting a completed printed circuit board (PCB).

1 .....

2 .....

[2]

Generally correctly answered by the majority of candidates.

Exemplar 1

1 ~~1~~ Poor quality soldering  
2 Broken components

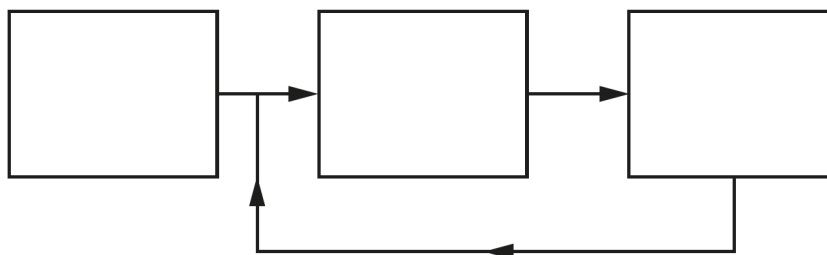
This candidate correctly stated two types of fault that a technician might find when visually inspecting a completed printed circuit board. A full mark of 2/2 was given for this response.

Question 4 (b)

(b) Fig. 7 shows the outline of a control system.

Add labels to Fig. 7 to show input, output, feedback and process.

Fig. 7



[4]

Generally answered correctly by the majority of candidates.

Question 5 (a)

5 (a) Calculate the current taken by a lamp of resistance  $46\ \Omega$  when connected to a  $230\text{V}$  supply.

.....

.....

.....

..... [4]

The formula for calculating current was generally well known with a high proportion of candidates obtaining high marks. Some candidates did not recall the formula  $R = V/I$  or state the unit amperes or amps or A.

Question 5 (b)

(b) Calculate the power absorbed by a solenoid of resistance  $0.75\ \Omega$  carrying a current of  $4\text{A}$ .

.....

.....

.....

..... [4]

Some candidates obtained high marks but with others the formula for calculating power was not generally well known. A number of candidates did not recall  $P = I^2 R$ , but a few candidates used  $P = VI$  having to calculate  $V$  using  $V = IR$  and then using  $P = VI$  to calculate power.

Exemplar 2

$P = I^2 R$

.....

$P = 16 \times 0.75 = 12$                       12 Watts

.....

This candidate correctly stated the formula  $P = I^2 R$  leading to a correct response of  $12\text{W}$ . A full mark of  $4/4$  was given for this response.

### Question 5 (c)

(c) State the units in which the following electrical quantities are measured:

Induction .....

Capacitance .....

[2]

The unit of capacitance was better known than the unit of induction.

### Question 6 (a)\*

6 (a)\* Discuss the function and applications of a voltage regulator in power supply circuits.

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

A number of candidates answered this question with a few giving a reasonable discussion of the function of a voltage regulator and naming applications. Candidates who did less well on this question did not offer a sensible discussion, often providing few facts and incorrect or vague applications.

In general terms it seemed that the use of spelling, punctuation and grammar has not improved in this series. In a number of cases the quality of hand writing was low.

### Question 6 (b)

- (b) Complete the table by identifying which components are input devices and which are output devices.

Component	Type of device – input or output
Light Emitting Diode (LED)	
NTC Thermistor	
Photodiode	
Relay	

[4]

Generally correctly answered by the majority of candidates.

### Exemplar 3

Component	Type of device – input or output
Light Emitting Diode (LED)	output
NTC Thermistor	input
Photodiode	input
Relay	output

This candidate correctly completed the table. A full mark of 4/4 was awarded for this response.

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