OCR
Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Examiners' report

SYSTEMS CONTROL IN ENGINEERING

J833, J843

R113 January 2021 series

Contents

© OCR 2021

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 are 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.

Would you prefer a Word version?

Did you know that you can save this PDF as a Word file using Acrobat Professional?

Simply click on **File > Export to** and select **Microsoft Word**

(If you have opened this PDF in your browser you will need to save it first. Simply right click anywhere on the page and select **Save as . . .** to save the PDF. Then open the PDF in Acrobat Professional.)

If you do not have access to Acrobat Professional there are a number of **free** applications available that will also convert PDF to Word (search for PDF to Word converter).

© OCR 2021

R113 series overview

A proportion of candidates attempted all six questions but knowledge of some sections of the specification appeared to be quite limited in a number of cases. Candidates should be encouraged to make their work as clear and legible as possible.

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 are asked to describe or explain functions and applications of components, it should be noted that justified responses need to be presented in order to gain the higher marks available. One-word or overly simplistic answers are not suitable responses to this type of question.

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.

There were also times when candidates did not address the command verbs in the question. When a question command verb is 'describe' or 'explain' candidates who answer with one word responses limit their ability to access the full range of marks available.

In a number of cases, responses to questions relating to basic electronic principles tended to be quite weak, with some candidates resorting to guesswork in order to provide an answer.

Not all candidates fully understood the difference between current flow, voltage, energy and power.

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:***
• Performed standard calculations following the given rubric. • Produced clear and concise responses for Level of Response questions. • Completed the graph correctly. • Applied knowledge and understanding to questions set in a novel context. • Completed tables with accuracy.	• Found it difficult to apply what they had learnt to unfamiliar situations. • Produced responses that lacked depth, and were often rambling and peripheral to what had been asked, sometimes simply repeating information provided. • Showed poor setting out of unstructured calculations. • Produced a graph that had little or no meaning at all. • Unable to complete tables accurately.

© OCR 2021

Question 1 (a)

1 Fig. 1 shows a circuit diagram.

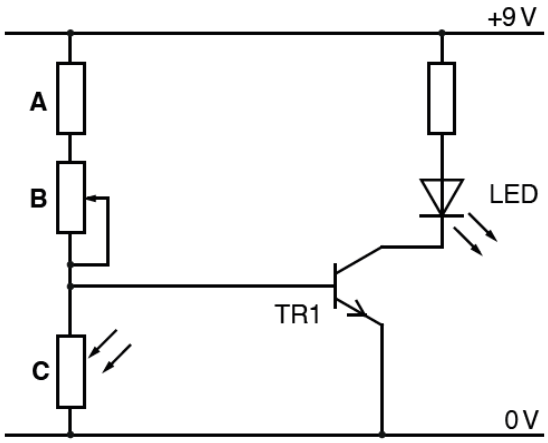


Fig. 1

(a) Name the components **A**, **B** and **C**.

A .....

B .....

C .....

[3]

Generally well answered by the majority of candidates. The least known component was the variable resistor.

Question 1 (b) (i)

(b) (i) State the full name of the LED.

L ..... E ..... D ..... **[1]**

Generally well answered by the majority of candidates but a number of candidates appeared to be guessing and came up with inappropriate answers.

Question 1 (b) (ii)

(ii) Describe the operating principle of an LED.

.....

.....

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

Generally well answered by the majority of candidates using the terms 'light' and 'current flow'. However a number of candidates appeared to be guessing and came up with incorrect answers.

© OCR 2021

Question 1 (c)

(c) State the name of the type of transistor TR1 shown in Fig. 1.

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

The correct answer is 'npn transistor' but a high proportion of candidates answered this question incorrectly.

Question 1 (d)

(d) Circle **three** of the following components that could replace the LED and resistor as an output in Fig. 1.

bell **photodiode** **Light Dependent Resistor**

buzzer **signal lamp** **thermistor**

[3]

Generally well answered, with a high proportion of candidates circling the correct answers of bell, buzzer and signal lamp. A few candidates chose other incorrect components.

Exemplar 1

The candidate clearly identifies the correct three components that could replace the LED and is therefore awarded full marks.

Question 2 (a)

2 Fig. 2 shows an RC series circuit.

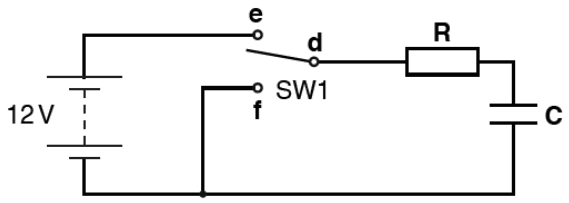


Fig. 2

(a) State which **two** contacts on SW1 must be connected for the capacitor to be charged.

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

A high proportion of candidates gave the correct answer of d and e. A few candidates struggled with this question.

© OCR 2021

Question 2 (b)

(b) Calculate the initial charging current in amps if **R** is 200 Ω.

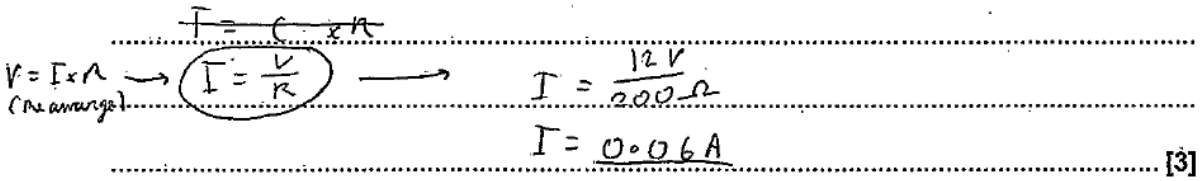
.....

.....

..... **[3]**

Generally well answered by a number of candidates. Lower ability candidates could not recall correctly the formula I = V/R.

Exemplar 2



[3]

The formula I = V/R was correctly applied giving a numerical answer of 0.06 A. 3 marks were awarded for a completely correct response.

Question 2 (c)

(c) Draw a curve on Fig. 3 to show the potential across capacitor **C** as it is discharging.

Fig. 3

[2]

A number of candidates produced a reasonable graph clearly showing the correct starting and finishing point of the discharge curve and drawing the correct curve.

Other candidates were not familiar with a discharging curve for a capacitor and therefore produced a range of incorrect curves and other shapes.

© OCR 2021

Question 2 (d)

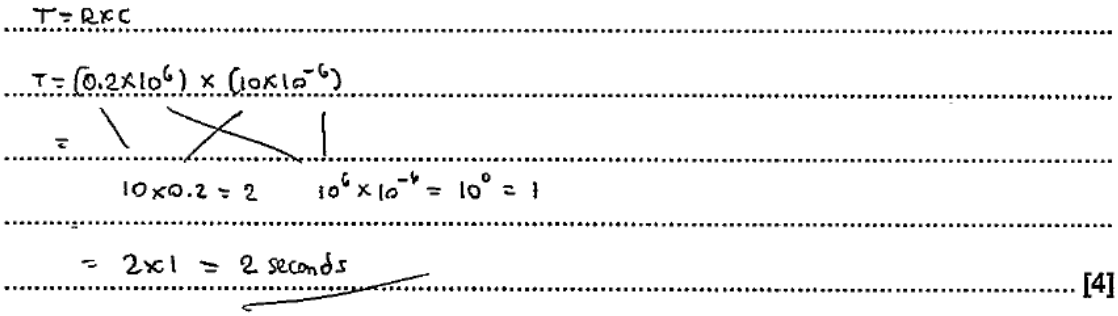
(d) A 10 μF capacitor is to be charged in series with a 0.2 MΩ resistor from a 100 V supply.

Use the formula T = RC to calculate the time constant T.

..... [4]

Generally well answered by a number of candidates. The main area of difficulty was converting a 0.2 megohm resistor into 200,000 ohms and converting a 10 microfarad capacitor into 0.00001 farads.

Exemplar 3



[4]

The formula T = RC was correctly applied giving a numerical answer of 2 seconds.
4 marks were given for a completely correct response.

Question 3 (a) (i)

3 **(a)** Two resistors of value 3 Ω and 2 Ω are connected in parallel to a 12 V supply.

(i) Calculate the total circuit resistance.

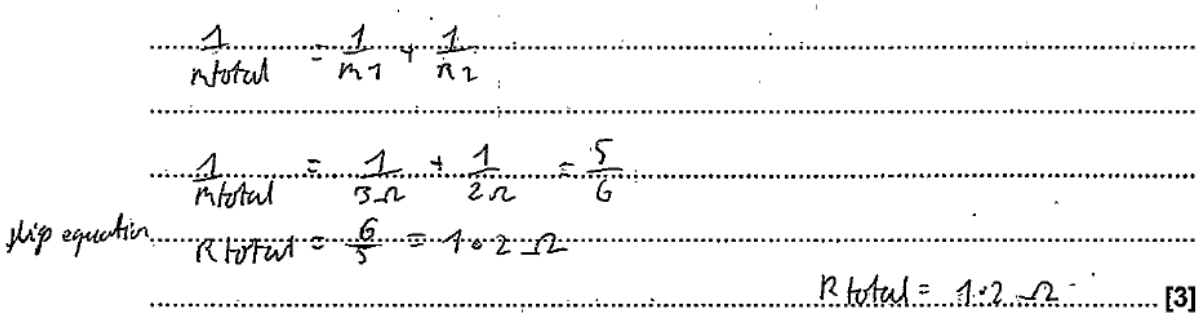
Use the formula $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$

..... [3]

Generally well answered by a number of candidates. Other candidates could not transpose the formula to give an equation for the total circuit resistance.

© OCR 2021

Exemplar 4



The given formula was correctly applied giving a correct answer of 1.2 ohm.
3 marks were given for a completely correct response.

Question 3 (a) (ii)

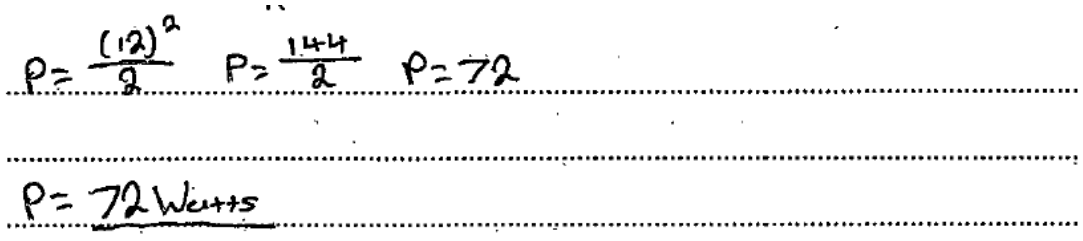
(ii) Calculate the power dissipated by the 2 Ω resistor.

Use the formula $P = \frac{V^2}{R}$

..... [3]

Generally well answered by a number of candidates. Other candidates seemed to struggle.

Exemplar 5



The given formula was correctly applied giving a correct answer of 72 W.
3 marks were given for a completely correct response .

© OCR 2021

Question 3 (b)

(b) Fig. 4 shows a potential divider circuit with an output voltage $V_{out} = 2\,V$.

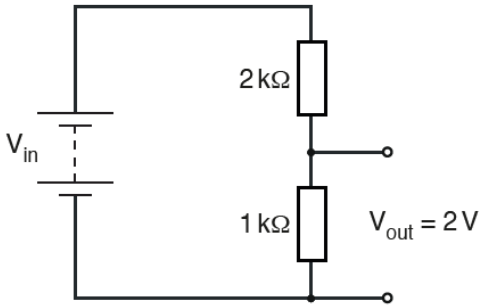


Fig. 4

Calculate the input voltage V_{in} of the circuit.

.....

.....

.....

.....

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

A number of candidates achieved full marks. Lower ability candidates struggled to calculate the input voltage of a potential divider circuit.

Question 4 (a)

4 **(a)*** Discuss the function and applications of a signal diode in an electronic circuit.

.....

.....

.....

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

A number of candidates answered this question, but only a few gave a reasonable discussion of the function of a signal diode. The applications named by candidates were wide ranging and mostly incorrect.

Candidates who did less well on this question tended to be incorrect or vague in their answers. The signal diode was often confused with a light emitting diode (LED).

Especially for questions like this, candidates should be encouraged to make their work as clear and legible as possible.

© OCR 2021

Question 4 (b)

(b) Fig. 5 shows a control system block diagram.

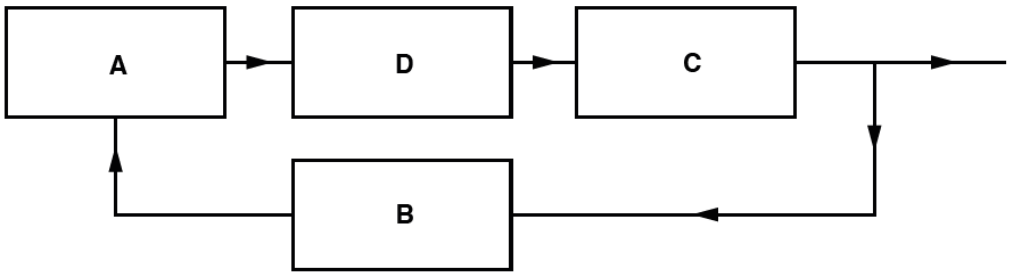


Fig. 5

State the parts of the control system at **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D .....

[4]

The majority of candidates answered this question correctly, gaining full marks. A few candidates were not aware of Block B being 'feedback' and Block D being 'process' or 'control'.

Question 5 (a)

5 **(a)** Name **two** fault finding procedures other than the truth table method of testing, that can be used on electronic circuits.

1 .....

2 .....

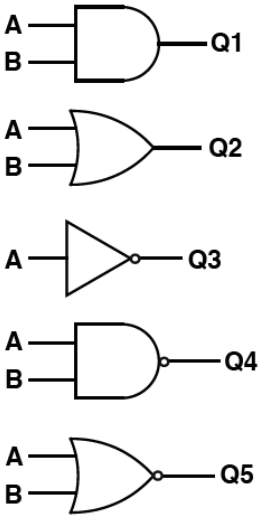
[2]

A number of candidates answered this question correctly with the fault finding procedures of 'visual inspection' and half split method'. Other candidates struggled.

© OCR 2021

Question 5 (b)

(b) A technician has used a logic probe to test the logic gates shown in Fig. 6.
Complete the truth table with the result that the technician would expect to get from the test.



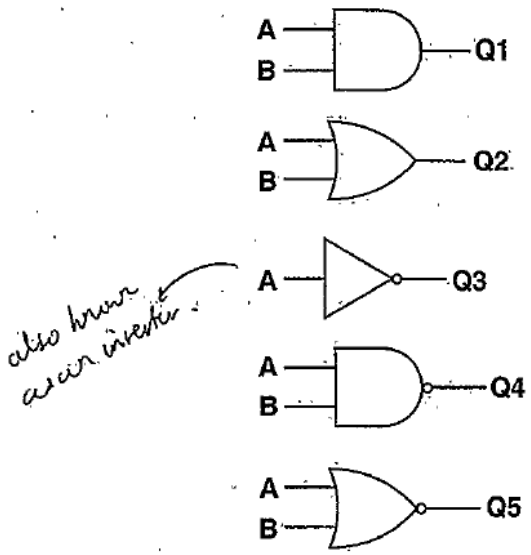
A	B	Q1	Q2	Q3	Q4	Q5
0	0					
0	1					
1	0					
1	1					

Fig. 6

[5]

Generally well answered by many candidates but others made a guess, which is not easy with truth tables.

Exemplar 6



A	B	Q1	Q2	Q3	Q4	Q5
0	0	0	0	1	1	1
0	1	0	1	1	1	0
1	0	0	1	0	1	0
1	1	1	1	0	0	0

Fig. 6

The truth table was completed correctly with the candidate being awarded full marks of 5.

© OCR 2021

Question 5 (c)

(c) Fig. 7 shows an industrial plant system using an OR logic gate and two operational amplifiers.

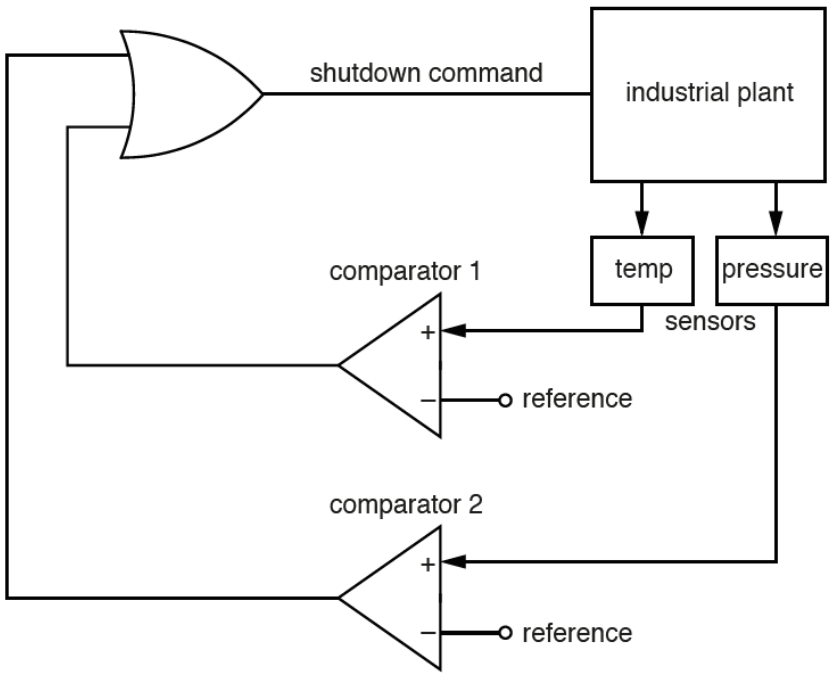


Fig. 7

Explain the function of the OR gate in this system.

.....

.....

.....

.....

..... **[3]**

Not a very popular question with candidates. Some gave responses that mentioned 'detect', and 'command' and 'safety'. Other candidates were obviously trying, but just didn't know the answer.

© OCR 2021

Question 6 (a)

6 **(a)** Name **two** commercial circuit construction methods other than the use of a pick and place robot.

1 .....

2 .....

[2]

A number of candidates did give correct responses, either choosing 'wave flow solder' or 'manual component replacement' or 'through hole technology'. Other candidates were not able to remember the correct answers.

Exemplar 7

1 Flow/wave Soldering

2 through hole Soldering

The candidate gave a correct response of 'wave flow soldering' and 'through hole technology' resulting in the maximum mark of 2.

Question 6 (b)

(b) Name **three** functions of a pick and place robot.

1 .....

2 .....

3 .....

[3]

Generally well answered by candidates with some obtaining the full 3 marks.

Question 6 (c)

(c) State **five** reasons why components are surface mounted rather than using the through hole system.

1 .....

2 .....

3 .....

4 .....

5 .....

[5]

A popular question with a number of candidates obtaining full marks of 5. Other candidates were obviously trying, but were not able to answer correctly.

© OCR 2021

Supporting you

Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website.

Active Results

Review students' exam performance with our free online results analysis tool available for GCSE, A Level and Cambridge Nationals.

It allows you to:

- review and run analysis reports on exam performance
- analyse results at question and/or topic level
- compare your centre with OCR national averages
- identify trends across the centre
- facilitate effective planning and delivery of courses
- identify areas of the curriculum where students excel or struggle
- help pinpoint strengths and weaknesses of students and teaching departments.

Find out more at ocr.org.uk/activeresults.

Supporting you through 2020-2021

Our priority is supporting you and your students as you prepare for summer 2021 exams. We'll update our website information regularly with resources, guidance and key information.

Take a look at our support for:

- Teachers
- Students
- Exams officers
- Assessment specialists

Keep up-to-date

We are sending a weekly roundup to tell you about important updates. You can also sign up for your subject specific updates.
If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. All our courses for the academic year 2020-2021 are being delivered live via an online platform, so you can attend from any location.

Please find details for all our courses on the relevant subject page on our website or visit OCR professional development.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals, Cambridge Technicals and Functional Skills qualifications. See the full list of available qualifications in the sign up form.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our Customer Support Centre.

General qualifications
01223 553998
general.qualifications@ocr.org.uk

Vocational qualifications
02476 851509
vocational.qualifications@ocr.org.uk

For more information visit
ocr.org.uk/i-want-to/find-resources/
ocr.org.uk
/ocrexams
/ocrexams
/company/ocr
/ocrexams

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Cambridge Assessment

OCR is part of Cambridge Assessment, a department of the University of Cambridge.

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored. © OCR 2021 Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee. Registered in England. Registered office The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA. Registered company number 3484466. OCR is an exempt charity.

OCR operates academic and vocational qualifications regulated by Ofqual, Qualifications Wales and CCEA as listed in their qualifications registers including A Levels, GCSEs, Cambridge Technicals and Cambridge Nationals.

OCR provides resources to help you deliver our qualifications. These resources do not represent any particular teaching method we expect you to use. We update our resources regularly and aim to make sure content is accurate but please check the OCR website so that you have the most up to date version. OCR cannot be held responsible for any errors or omissions in these resources.

Though we make every effort to check our resources, there may be contradictions between published support and the specification, so it is important that you always use information in the latest specification. We indicate any specification changes within the document itself, change the version number and provide a summary of the changes. If you do notice a discrepancy between the specification and a resource, please contact us.

You can copy and distribute this resource freely if you keep the OCR logo and this small print intact and you acknowledge OCR as the originator of the resource.

OCR acknowledges the use of the following content: N/A

Whether you already offer OCR qualifications, are new to OCR or are thinking about switching, you can request more information using our Expression of Interest form.

Please get in touch if you want to discuss the accessibility of resources we offer to support you in delivering our qualifications.