OCR
Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Examiners' report

SYSTEMS CONTROL IN ENGINEERING

J833, J843

R113 January 2019 series

Version 1

Contents

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 can be downloaded from OCR.

Paper R113 series overview

While several candidates attempted all six questions, knowledge of some sections of the specification appeared to be quite limited in some cases. This was confirmed by a significant increase in the number of questions to which no response was given.

It was apparent that not all candidates had read the 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. There were instances when candidates were not addressing the command verbs in the question. One-word or overly simplistic answers are not suitable responses to this type of question.

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

In several cases responses to questions relating to basic electronic principles were disappointing in the main, with some candidates apparently resorting to guesswork in order to provide any sort of an answer.

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

Candidate Performance overview:

Candidates who did well on this paper generally did the following:

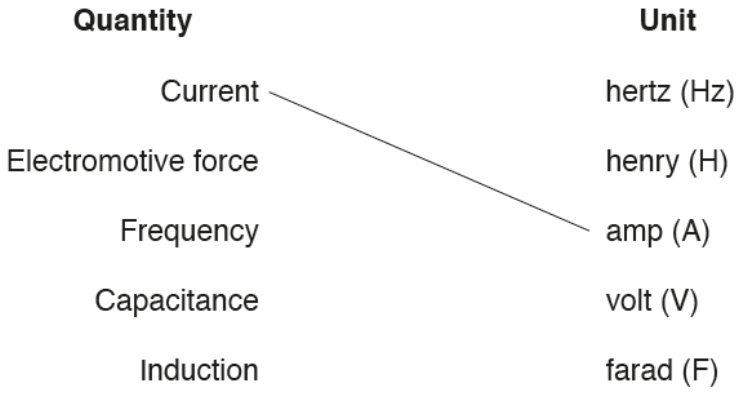
- Performed standard calculations following the given rubric.
- Produced clear and concise responses for Level of Response questions.
- Completed block diagrams placing input, output and feedback words in correct positions.
- Applied knowledge and understanding to questions set in a novel context.
- Completed tables and connecting lines questions with accuracy.

Candidates who did less well on this paper generally did the following:

- Found it difficult to apply what they had learnt to unfamiliar situations.
- Produced responses that lacked depth, sometimes simply repeating information provided.
- Showed poor setting out of unstructured calculations.
- Were unable to complete tables or connecting lines question with any degree of accuracy.

Question 1(a)

1 **(a)** Draw lines to connect each quantity to the correct unit.
The first one has been done for you.



[4]

A mixed response was made to this question. While a number of candidates secured full marks, a number of candidates could not link the quantity electromotive force with the unit volt.

Question 1(b)

(b) Calculate the total resistance in ohms, of 4 Ω and 6 Ω resistors, connected in series.

.....

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

The formula for calculating the total resistance of two resistors connected in series was generally well known with a high proportion of candidates obtaining high marks. However, some candidates could not recall $R = R_1 + R_2$.

Question 1(c)

(c) A potential difference of 6 V is applied across the terminals of a 300 Ω resistor.

Calculate the current, in amps, flowing through the resistor.

.....

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

The formula for calculating the current flowing through a resistor was generally well known with a high proportion of candidates obtaining high marks. However, some candidates could not recall $I = V/R$.

Question 1(d)

(d) Calculate the energy use in kilowatt hours when a 500 W heater is in use for **two** hours. State the units in your answer.

.....

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

The formula for calculating energy used by a heater was generally well known with a proportion of candidates obtaining high marks. However, some candidates could not recall Energy W = Pt or that the unit of energy kilowatt hour is written as kWh.

Question 2(a)

2 Fig. 1 shows a circuit diagram.

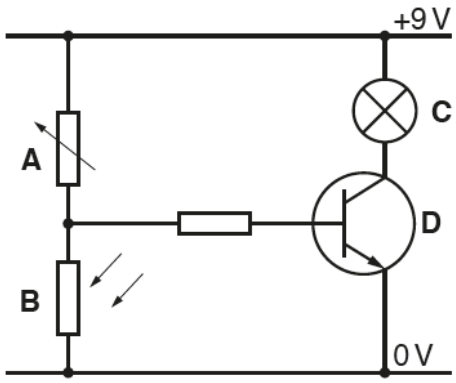


Fig. 1

(a) Complete the table below by naming each component from its symbol shown in Fig. 1.

Symbol	Component
A	
B	
C	
D	

[4]

This question was generally well answered with the majority of candidates completing the table correctly. A few candidates, however, could not name the signal lamp and the variable resistor correctly. Several candidates gave the incorrect answer for symbol 'C' as a 'filament lamp'. Centres are reminded that the signal lamp is probably one of the most basic symbols used in electronic engineering and should be recognised by most candidates.

Question 2(b)

(b) Explain why a fuse would be connected in the circuit shown in Fig. 1.

.....

.....

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

This was generally well answered showing candidates had an understanding that the fuse is a protective device. However, a number of candidates did not understand the difference between current, voltage and power surges.

Question 2(c)

(c) Fig. 2 shows a potential divider circuit.

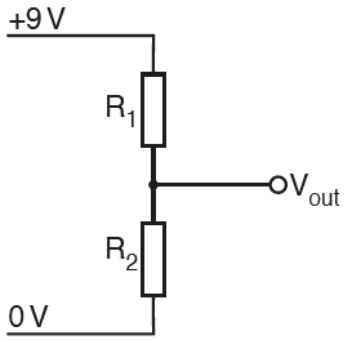


Fig. 2

Calculate the output voltage V_{out} when $R_1 = 30\,k\Omega$ and $R_2 = 20\,k\Omega$.

.....

.....

.....

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

The formula for calculating the output voltage was not well known. A proportion of candidates did obtain full marks. Those that could not recall the formula correctly lost marks and subsequently provided a numerical answer that was incorrect.

Exemplar 1

Calculate the output voltage V_{out} when $R_1 = 30\,k\Omega$ and $R_2 = 20\,k\Omega$.

$V_{out} = \frac{R_2}{R_1+R_2} \times V_s = \frac{20k}{30k+20k} \times 9 = \frac{20k}{50k} \times 9 = \frac{2}{5} \times 9 = \frac{18}{5} = 3.6V$

[4]

This answer shows how full marks can be obtained by recalling the correct formula and substituting correct numerical values.

Question 3(a)

3 (a) State **three** benefits of using a virtual oscilloscope for testing a simulated circuit.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

This question was generally well answered with a variety of benefits given for using a virtual oscilloscope for testing a simulated circuit. The language used was sometimes not sufficiently technical, but the sense could be interpreted as correct.

Question 3(b)(i)

(b) Fig. 3 shows a virtual oscilloscope being used to display a signal from a signal generator. The signal properties can be changed in the signal generator properties window.

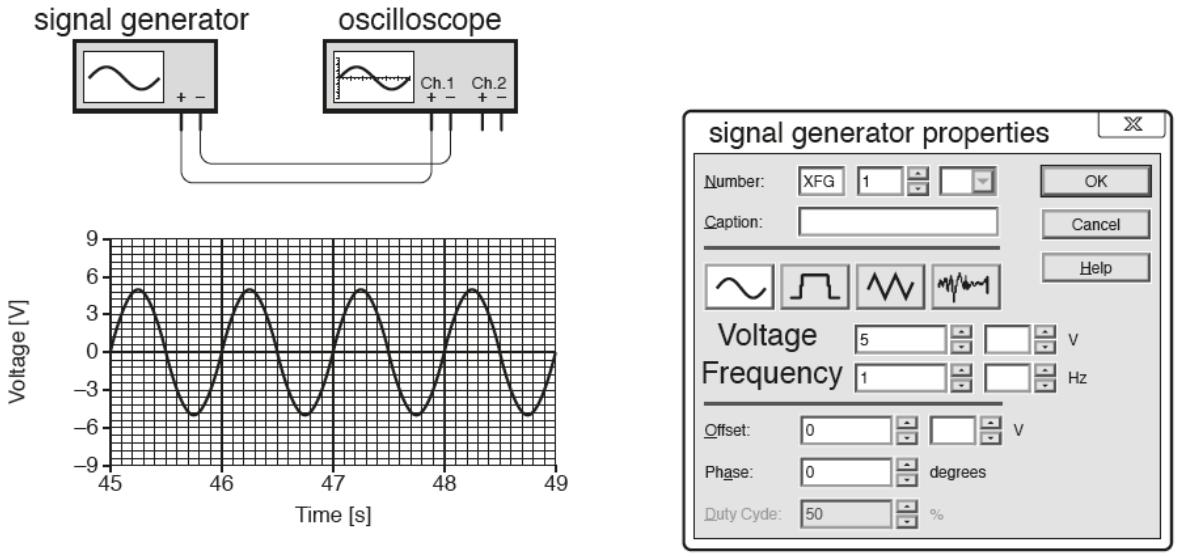


Fig. 3

Explain what happens to the signal when the following oscilloscope controls are adjusted in signal generator properties.

(i) Voltage

.....

.....

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

Most candidates produced responses that had very little to do with the question. They demonstrated a lack of knowledge and often produced responses with little or no information being provided. This was possibly the weakest question on the examination paper in terms of responses.

Exemplar 2

(i) Voltage

The amplitude of the wave will increase or decrease with the voltage

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

The candidate stated correctly that the voltage control concerns the movement of the amplitude of the waveform either giving an increase or decrease giving an award worth two marks.

Question 3(b)(ii)

(ii) Frequency

.....

.....

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

Most candidates produced responses that had very little to do with the question in a like manner to question 3(b)(i). They demonstrated a lack of knowledge and often provided responses with little or no information.

Exemplar 3

(II) Frequency

The number of visible waves will increase / decrease with the frequency.

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

This candidate stated correctly that the frequency control concerns the movement of the wave i.e. wave length (horizontal movement) either giving an increase or decrease and so was awarded two marks.

Question 3(c)(i)

(c) Fig. 4 shows a waveform from the virtual oscilloscope with a dimension added.

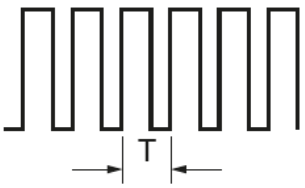


Fig. 4

(i) State the name of the type of signal that would produce the waveform shown in Fig. 4.

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

While a relatively straightforward question, most candidates produced responses that had very little to do with the type of signal that would produce the type of waveform shown. They demonstrated a lack of knowledge and often provided responses with little or no information being provided.

Question 3(c)(ii)

(ii) Describe how the value of 'T' is used to calculate the frequency of the signal.

.....

.....

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

Most candidates produced responses that were unrelated with the question. They demonstrated a lack of knowledge, often providing responses with little or no information being provided. A few candidates did correctly state
f = 1/T.

Exemplar 4

(ii) Describe how the value of 'T' is used to calculate the frequency of the signal.

T is the period of the wave, i.e. the time for one wave to oscilate - to calculate frequency, T is inversed, i.e. $f = \frac{1}{T}$ and thus the frequency is found (T must be in s so Hz is) **[2]**

Two marks were awarded for this clear and precise answer. One mark for T time and one mark for f = 1/T.

Question 4(a)

4 **(a)** Complete the table using a tick (✓) to identify the **three** process devices.

Device	(✓)
Diode	
Pressure switch	
Operational amplifier	
Touch screen	
OR gate	
LED 7 segment display	

[3]

This question was generally well answered with the majority of candidates completing the table correctly with three ticks in accordance with instructions given in the question. A few candidates did, however, choose an incorrect process device such as the pressure switch and the LED 7 segment display.

Question 4(b)(i)

(b) Fig. 5 shows a logic circuit made from two logic gates.

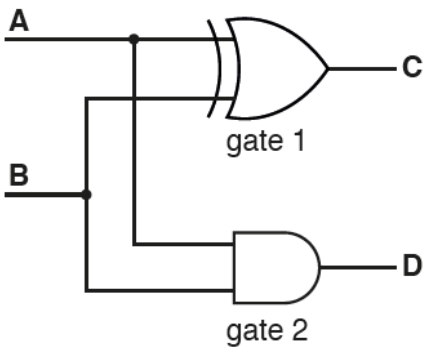


Fig. 5

(i) Name the **two** logic gates that are shown in Fig. 5.

gate 1 .....

gate 2 .....

[2]

A generally well answered question with a high proportion of candidates obtaining full marks. The AND gate received more marks than the XOR gate.

Question 4(b)(ii)

(ii) Complete the truth table for the circuit in Fig. 5.

A	B	C	D
0	0		
0	1		
1	0		
1	1		

[2]

While a number of candidates did achieve full marks, a number were unable to demonstrate the required knowledge and understanding of how to complete a truth table for a given circuit. The least known output being the XOR gate.

Question 4(c)

(c) Fig. 6 shows the pin arrangement for a 4017 single digit decade counter IC.

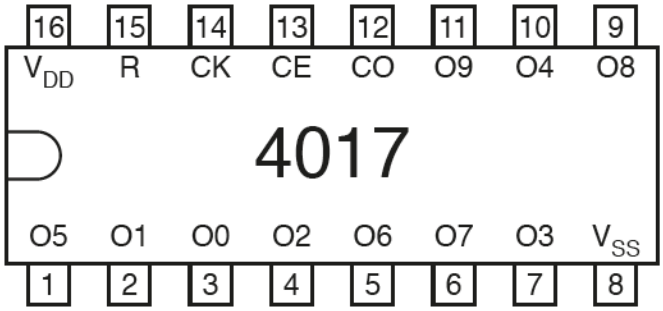


Fig. 6

Pins 1 to 7 and 9 to 11 are outputs for the counter, pin 14 is the clock pin and pin 15 is the reset pin.

State the purpose of pins 8, 14 and 15.

Pin 8 .....

Pin 14 .....

Pin 15 .....

[3]

Most candidates produced responses that had very little relevance with the question. They demonstrated weak knowledge and often provided responses with little or no information.

Question 5(a)

5 Fig. 7 shows a block diagram of a control system.

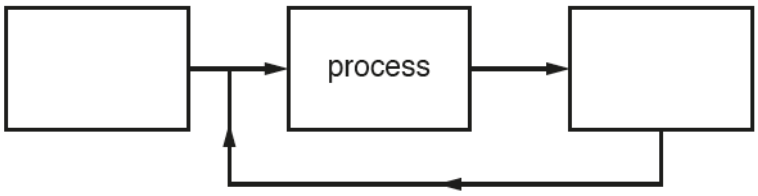


Fig. 7

(a) Label Fig. 7 with the terms; 'input', 'feedback' and 'output'. **[3]**

A generally well answered with a high proportion of candidates labelling the blocks correctly.

Question 5(b)

(b) State the name of **three** manufacturing processes that are used to construct commercial printed circuit boards.

1 .....

2 .....

3 .....

[3]

Candidates who did well on this question provided all the correct manufacturing processes and therefore received high marks. Other candidates gave irrelevant answers with a number being guesses.

Exemplar 5

(b) State the name of **three** manufacturing processes that are used to construct commercial printed circuit boards.

1 Flow (wave) soldering

2 Pick and Place robots

3 Manual component ~~plota~~. Placement -

[3]

This candidate correctly stated three manufacturing processes giving an award of three marks.

Question 5(c)

(c) Fig. 8 shows two methods for commercial circuit construction of a circuit board.

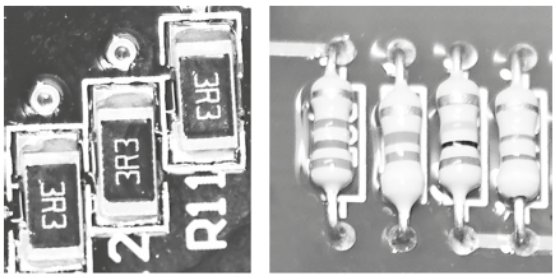


Fig. 8

State the type of commercial circuit construction that is being shown at:

A .....

B .....

[2]

This question was generally well answered with a high proportion of candidates stating correctly the type of commercial circuit construction being shown. Other candidates provided answer that were unrelated to the question being asked.

Question 5(d)

(d) State the name of **two** quality assurance methods that are used during commercial printed circuit board (PCB) production.

1 .....

2 .....

[2]

A generally well answered with the most popular correct answer being 'visual inspection'.

Question 6(a)*

6 **(a)*** Discuss the function and applications of a reed switch and a micro switch in electronic circuits.

.....

.....

.....

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

A proportion of candidates answered this question with a few giving a reasonable discussion of the function of a reed switch and a micro switch. The applications named by candidates were wide ranging with some being irrelevant. Candidates who did less well on this question did not provide a very coherent discussion often producing a response with little or few facts being provided and with incorrect or vague applications. In general the use of spelling, punctuation and grammar remained the same as in previous series.

Question 6(b)

(b) Calculate the time constant for a switching circuit when a 400 μF capacitor is connected in series with an 800 Ω resistor across a 230 V supply.

Use the formula T=RC. State the units in your answer.

.....

.....

.....

.....

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

A proportion of candidates answered this question correctly. The remainder could not correctly convert 400 μF into 0.0004 F which resulted in an incorrect answer.

Exemplar 6

Use the formula T=RC. State the units in your answer.

T = 800Ω x 400pF T = 0·32 Mili $\times 10^{-3}$

800 x 0·000400F Micro $\times 10^{-6}$

800 x 4^{-04} = 0·32 5 nano $\times 10^{-9}$

12·5 pico $\times 10^{-12}$ **[4]**

This candidate was awarded four marks for correctly converting microfarads to farads and then using the formula T =RC correctly to give an answer of 0.32 s.

Supporting you

For further details of this qualification please visit the subject webpage.

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. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

activeresults

Active Results offers a unique perspective on results data and greater opportunities to understand students' performance.

It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/administration/support-and-tools/active-results/

CPD Hub
Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

OCR Resources: *the small print*
OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

This resource may be freely copied and distributed, as long as the OCR logo and this small print remain intact and OCR is acknowledged as the originator of this work.

Our documents are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published support and the specification, therefore please use the information on the latest specification at all times. Where changes are made to specifications these will be indicated within the document, there will be a new version number indicated, and a summary of the changes. If you do notice a discrepancy between the specification and a resource please contact us at: resources.feedback@ocr.org.uk.

OCR acknowledges the use of the following content:
Square down and Square up: alexwhite/Shutterstock.com

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

www.ocr.org.uk

OCR Customer Support Centre

Vocational qualifications

Telephone 02476 851509
Facsimile 02476 851633
Email vocational.qualifications@ocr.org.uk

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.*

Cambridge Assessment

CERTIFIED ISO 9001 UKAS MANAGEMENT SYSTEMS 001