OCR
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CAMBRIDGE NATIONALS

Examiners' report

SYSTEMS CONTROL IN ENGINEERING

Cambridge NATIONALS

J833, J843

R113 Summer 2018 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

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. This was confirmed by a significant increase in the number of questions to which no response was given.

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 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.

There are times when candidates are not addressing the command verbs in the question. When a question command verb is 'describe', or 'explain' candidates are answering with one word responses which limits their ability to access the full range of marks available.

In a number of cases responses to questions relating to basic electronic principles was less than expected, with some candidates seeming to resort to guesswork in order to provide any sort of an answer.

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.

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.
- Drew clear diagrams for potential divider circuits.
- Completed circuit diagrams placing voltmeters and an ammeter 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, and were often rambling and peripheral to what had been asked, sometimes simply repeating information provided.
- Showed poor setting out of unstructured calculations.
- Produced diagrams and completed circuits that had little or no meaning at all.
- Unable to complete tables or connecting lines question with any degree of accuracy.

Question 1 (a)

1 (a) Complete the table by drawing the graphical symbol for each component listed.

Component	Symbol
AND Gate	
Capacitor	
Fuse	
Buzzer	

[4]

This question was generally well answered but the symbol for a buzzer was not well known.

Question 1 (b)

(b) Calculate the current, in amps, flowing through a 100 Ω resistor connected across a 2 V supply.

.....

.....

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

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 (c)

(c) Calculate the power, in watts, absorbed by a heater of resistance 220 Ω when a current of 2 A is flowing.

.....

.....

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

The formula for calculating the total power used in the circuit was reasonably well known with a number of candidates being credited full marks. However some candidates could not recall $P = I^2R$ or any other power formula.

Question 2 (a)

2 **(a)** Complete the table below using a tick (✓) to identify **four** output devices.

Component	Output device
Solenoid	
Liquid Crystal Display module	
Microphone	
Piezo-electric buzzer	
Pressure switch	
Seven Segment display	
NCT thermistor	

[4]

This question was generally well answered with the majority of candidates completing the table correctly with four ticks in accordance with instructions given in the question. However, a few candidates did choose an incorrect output device, such as the NCT Thermistor and/or the pressure switch.

Question 2 (b)

(b) The frequency of oscillation in an astable circuit is given by f = 1/(1.38 RC) where R is in ohms and C is in farads.
Calculate the frequency of oscillation in Hertz given that R = 110 kΩ and C = 3.3 μF.

.....

.....

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

This was not a well answered question. A high proportion of candidates could not convert 3.3 μF into 0.0000033 F which resulted in an incorrect answer.

However a few candidates produced a correct solution converting 110 kΩ into 110000 Ω and using 0.0000033 F to give an answer of 2 Hz.

Question 2 (c)

(c) Complete the truth table below for the following two-input gates: OR, AND, NAND.

Input **A**	Input **B**	**OR gate output**	**AND gate output**	**NAND gate output**
0	**0**			
0	**1**			
1	**0**			
1	**1**			

[3]

Many candidates were unable to demonstrate the required knowledge and understanding of how to complete a truth table for a stated gate.

A number of candidates did achieve full marks with the least known output being the NAND gate.

Question 3 (a) (i)

3 **(a)** Different manufacturing processes are used in commercial circuit construction.

(i) Explain what is meant by the 'flow (wave) solder' process.

.....

.....

.....

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

The majority of candidates produced responses that had very little to do with the flow (wave) solder process. They lacked knowledge and often rambled on with little or no information being provided. This was possibly the worst answered question on the examination paper.

Question 3 (a) (ii)

(ii) Explain what is meant by the 'pick and place robot' process.

.....

.....

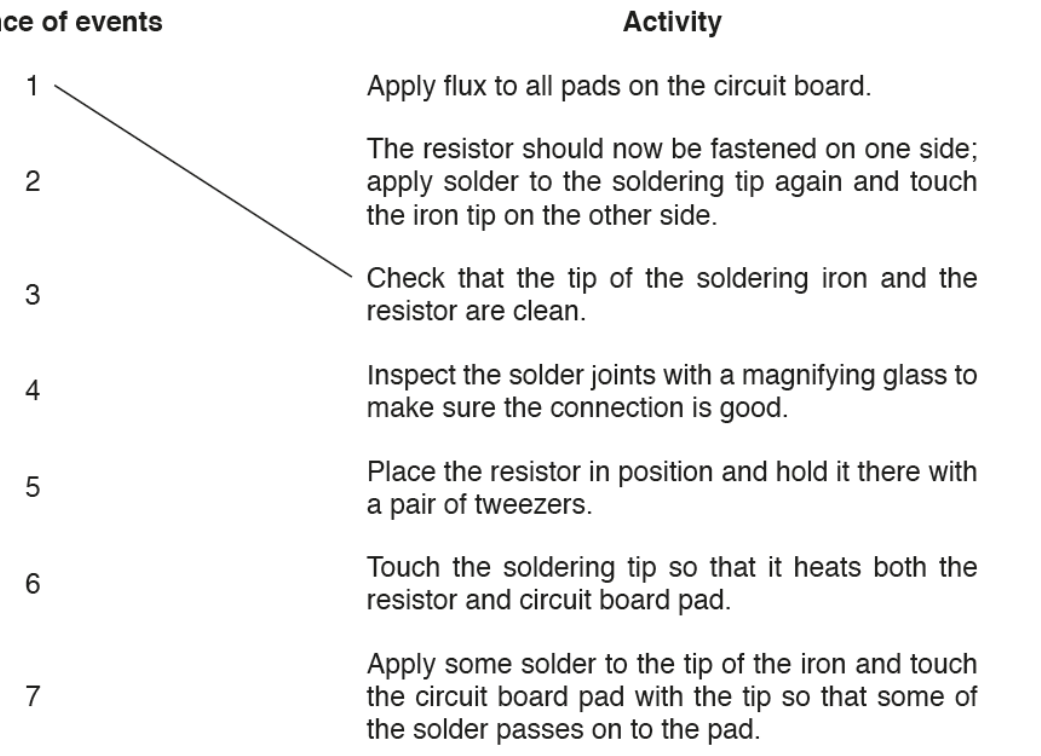
.....

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

This question was generally well answered, but low level responses only really used information provided in the question stem.

Question 3 (b)

(b) Draw lines to connect each activity to the correct sequence of events for soldering a surface mount resistor on to a printed circuit board (PCB).
The first one has been done for you.



[6]

There were mixed responses to this question. A number of candidates obtained full marks. Events 2, 6 and 7 seemed to be well thought out but some confusion was seen with events 3, 4 and 5.

Question 4 (a)

4 **(a)*** Discuss the function and applications of a light dependent resistor (LDR) and a light emitting diode (LED).

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

A high proportion of candidates answered this question with many giving a reasonable discussion of the function of a light dependent resistor (LED) and a light emitting diode (LED). The applications named by candidates were wide ranging. A popular answer for the LDR application was a street light and a senor and for the LED was as an indicator light in one of its many forms.

Candidates who did less well on this question did not give a very sensible discussion often rambling on with little or few facts being provided and providing incorrect or vague applications. In general terms it seemed that the use of spelling, punctuation and grammar had improved in this series.

Question 4 (b)

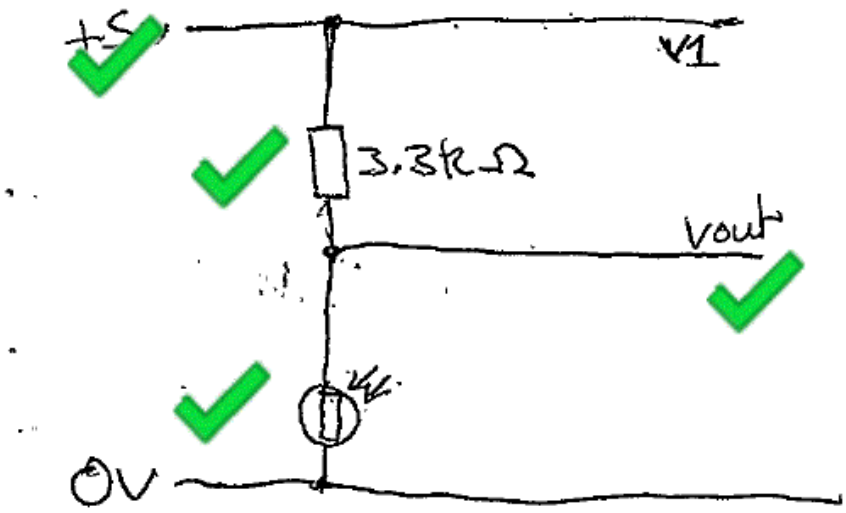
(b) Draw a potential divider circuit consisting of a light dependent resistor (LDR) connected to a 3.3 kΩ resistor. One end of the 3.3 kΩ resistor is connected to a +5 V supply.

[4]

Candidates who did well on this question provided high quality drawings clearly showing all of the components in the correct positions and identifying the connection that made the circuit a potential divider.

Candidates who did less well produced low quality drawings with incorrect graphical symbols and in many cases did not produce a potential divider circuit

Exemplar 1



Question 5 (a)

5 Fig. 1 shows an incomplete circuit diagram.

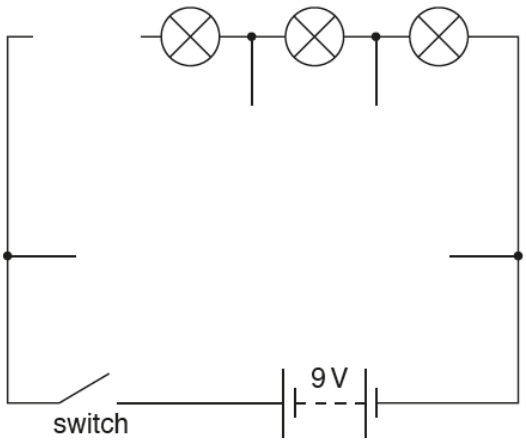


Fig. 1

(a) Complete the circuit diagram in Fig. 1 with:

- an ammeter to measure total current flow
- a voltmeter to measure the potential difference across one lamp
- a voltmeter to measure the circuit electromotive force (EMF).

[3]

Candidates who did well on this question completed the circuit diagram correctly using the correct symbols for voltmeters and ammeters and placed them in the correct positions.

Candidates who did less well produced incorrect voltmeter and ammeter symbols and placed them anywhere in the circuit regardless of connections and position.

Question 5 (b) (i)

(b) (i) State the contact arrangement of the switch used in the circuit.

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

A minority of candidates answered this question correctly with the response 'single pole single throw' (SPST).

Centres are reminded that this is probably one of the most basic symbols used in electronic engineering and should be recognised by a very high proportion of candidates.

Question 5 (b) (ii)

(ii) State what type of lamp is used in the circuit.

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

A minority of candidates answered this question correctly with the correct response 'signal'. A number of candidates gave the incorrect answer as a 'filament lamp'.

Centres are reminded that this is probably one of the most basic symbols for lamps used in electronic engineering and should be recognised by the majority of candidates.

Question 5 (c) (i)

(c) (i) Calculate the total resistance of the lamps if each lamp has a resistance of 1.8 Ω.

.....

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

The formula for calculating the total resistance of three lamps in series was well known with the majority of candidates obtaining maximum marks.

Question 5 (c) (ii)

(ii) Calculate the energy consumed in 10 hours by one lamp that is rated at 4 W.

.....

.....

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

The formula for calculating the energy used by one lamp W =Pt was reasonably well known but there was much confusion when dealing with the unit of energy.

The least complicated method was W = Pt = 4 x 10 = 40 Wh.

A number of candidates chose to calculate the energy in kWh, Ws or J which is perfectly acceptable if time and power is correctly converted to its appropriate unit.

A few candidates correctly calculated the energy as 0.04 kWh or 144000 Ws or 144000 J.

Question 6 (a)

6 (a) State the name of **three** techniques that are used to identify potential electrical hazards.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

This was a badly answered question with no candidate naming correctly three techniques that are used to identify potential electrical hazards.

The most popular correct answer was 'visual inspection'. The most bizarre answer was 'destructive testing'.

Centres are referred to Learning Outcome 3 in the specification.

Question 6 (b)

(b) Give **two** reasons for using a virtual signal generator to test a simulated circuit.

1 .....

.....

2 .....

.....

[2]

This was generally well answered with a variety of reasons given for using a virtual signal generator to test a simulated circuit. The language used was sometimes not very technical but the sense could be interpreted as correct.

Question 6 (c) (i)

(c) Fig. 2 shows a virtual signal generator.

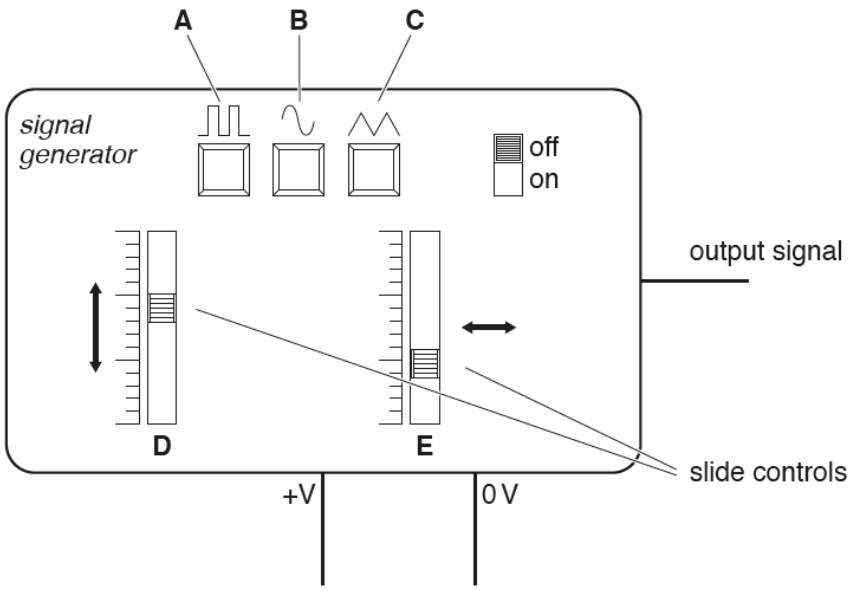


Fig. 2

(i) State the name of the wave form at **A**, **B** and **C** in Fig. 2.

A .....

B .....

C .....

[3]

Candidates who did well on this question provide all of the correct answers and received high marks. Other candidates gave silly answers with a number being pure guesses. The most popular response was the sine wave with the triangular wave being the least popular.

Question 6 (c) (ii)

(ii) Fig. 2 shows two slide controls, **D** and **E**.
State the function of slide controls **D** and **E**.

D .....

E .....

[2]

The slide control D is used to control amplitude. A few candidates used this type of response. Other candidates knew it was something that went up and down with height change being a popular response. The slide control E is used as a frequency multiplier or a wavelength multiplier. Again a few candidates gave this type of response. Other candidates knew it was something that went side to side with length being a popular response.

A number of candidates gave totally incorrect responses using guesswork.

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