

CAMBRIDGE NATIONALS

Examiners' report



SYSTEMS CONTROL IN ENGINEERING

J833, J843

R113 January 2020 series

Version 1

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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 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. The standard of presentation and handwriting was sometimes poor, making some responses difficult to follow.

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 did not address 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 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 absolutely necessary because sufficient space for an answer has been provided on the examination paper.


Summary of candidate performance:

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 diagrams correctly, including labelling.
- Applied knowledge and understanding to questions set in a novel context.
- Completed tables with accuracy.

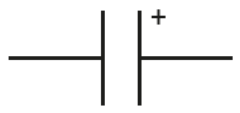
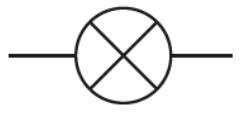

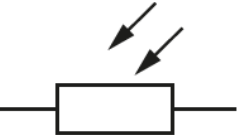
Candidates who did less well on this paper generally did the following.

- Found it difficult to apply what they had learnt to unfamiliar situations.
- Produced responses that lacked depth, and which were peripheral to what had been asked, sometimes simply repeating information provided.
- Showed poor setting out of unstructured calculations.
- Produced diagrams that contained little or no information or detail.
- Failed to complete tables with any degree of accuracy.

	OCR support	<p>Candidates could be directed to the OCR Cambridge Technicals Command Verbs guidance document available from the OCR website: https://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf</p> <p>This explains the meaning of command verbs and their use in assessments, along with examples. While intended for the Cambridge Technicals, this will nevertheless provide useful guidance on command verbs used in the Cambridge Nationals.</p>
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Question 1 (a)

- 1 (a) Complete the table by naming the component for each electronic symbol shown. Part of each answer has been given for you.

Symbol	Component
	polarised
 lamp
 to switch
 resistor

[4]

This question was generally well answered by the majority of candidates. The least known component symbol was the push to make switch.

Question 1 (b)

- (b) Calculate the resistance in ohms of a lamp rated at 12 volts 0.5 amperes.

.....

.....

.....

..... [3]

Part (b) of the questions was generally well answered by candidates. The main weakness evidence in responses was that candidates could not recall correctly the required formula $R = V/I$

Question 1 (c)

(c) Calculate the energy in kilowatt hours when a 900 watt hairdryer is used for 10 minutes.

.....

.....

.....

..... [3]

Part (c) of this question proved unpopular with candidates. Candidates often could not recall the formula $W = Pt$ with energy W often being replaced with E . Benefit of the doubt was applied to candidates who used E instead of W . Candidates struggled with unit conversions and could not convert 900 W to kilowatts and 10 minutes to hours.

Exemplar 1

(c) Calculate the energy in kilowatt hours when a 900 watt hairdryer is used for 10 minutes.

900 W = 0.9 kW

10 mins = ~~600 seconds~~ 0.16 hours

$E = P \times t$

$E = 0.9 \times 0.16 = 0.15$ 0.15 kWh [3]

This candidate correctly converted 900 W to 0.9 kW and 10 minutes to 0.16 hours. The formula $W = Pt$ was correctly applied giving a numerical answer of 0.15 kWh. The mark awarded for a completely correct response was therefore 3/3.

Question 1 (d)

(d) Circle the **two** polarised capacitors in the list of capacitor types below.

- ceramic polyester electrolytic polystyrene tantalum

[2]

This question was generally well answered by a high proportion of candidates circling the correct answers of electrolytic and tantalum. A few candidates chose incorrectly ceramic.

Question 2 (a)

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

The first one has been done for you.

Component	Type of Device
Solenoid	Output
Relay	
Microphone	
Phototransistor	
Pressure switch	
Light Emitting Diode	
Touch screen	

[6]

This question was generally well answered by the majority of candidates. The phototransistor seemed to be the least known component as an input device.

Question 2 (b) (i)

(b) The diagram below shows a resistor and a colour code chart.



Colour	Band 1	Band 2	Band 3	Band 4
Black	0	0	×1	
Brown	1	1	×10	±1%
Red	2	2	×100	±2%
Orange	3	3	×1K	
Yellow	4	4	×10K	
Green	5	5	×100K	±0.5%
Blue	6	6	×1M	±0.25%
Violet	7	7	×10M	
Grey	8	8		
White	9	9		
Gold			×0.1	±5%
Silver			×0.01	±10%

(i) State the value of a resistor colour coded Brown, Grey, Red and Gold.

.....
 [3]

For part (b) a number of candidates gave the correct response $1800\ \Omega \pm 5\%$ or $1.8\ \text{K}\ \Omega \pm 5\%$. Other candidates had little idea how to answer this question, often resorting to guessing a response.

Question 2 (b) (ii)

(ii) State why resistors of different power ratings are available.

..... [1]

The majority of candidates had limited knowledge as to why a resistor of different power ratings are available to be used in circuits. A few candidates did have some understanding of power rating of a resistor, correctly considering 'heat' and 'current'.

Question 3 (a)

3 A multimeter is used to test electronic circuits.

(a) Name **four** other pieces of equipment that are used to test electronic circuits.

- 1
- 2
- 3
- 4

[4]

This question was generally well answered by a high proportion of candidates. A few, however, re-stated 'multimeter' which is in the stem of the question which resulted in the loss of a mark. A few candidates stated incorrectly residual current breaker and PAT testing.

Question 3 (b) (i)

(b) (i) Describe **four** stages in using a multimeter to test for continuity in a fuse.

-
-
-
-
-
-
-
-
-
-

[4]

Part (b) was generally well answered by a few candidates. Other candidates demonstrated a lack of knowledge required to provide a coherent response, and often responded with incorrect or irrelevant information.

Exemplar 2

- Attach the black wire and red wire to the multimeter dial
- Switch multimeter to continuity test mode
- place the black and red wire needles to either side each side of the fuse
- The "beep" sound will be heard from the multimeter indicating that it has measured continuity. [4]

This candidate gave four correct stages in using a multimeter to test for continuity in a fuse resulting in a maximum mark of 4/4

Question 3 (b) (ii)

(ii) Give **two** other specific uses for a multimeter.

- 1
- 2

[2]

Part (b) (ii) of the questions was generally well answered by a majority of candidates. The most popular answer was for voltage and current measurements.

Question 4 (a)

- 4 (a) Complete the table below by naming **three** benefits and **three** drawbacks of using surface mount components in commercial circuit construction.

The first one has been done for you.

Statement	Benefit or Drawback
The components of SMT are smaller.	Benefit
Fewer holes need to be drilled onto the circuit board.
Large, high-power or high-voltage parts are unsuitable for surface mount construction.
Manual prototype or component level repair is more difficult.
Skilled operators are needed with expensive tools as the parts are much smaller.
Components can be placed on either side of the circuit boards.
Better mechanical performance under shake and vibration conditions.

[6]

This question was generally well answered by most candidates, who were able to give all six correct answers. This question was probably the most popular on the paper.

Question 4 (b)

- (b) Visual Inspection is one method used within quality assurance in commercial printed circuit board (PCB) production.
Describe the visual checks that the manufacturer can carry out.

.....

.....

.....

.....

.....

.....

..... [4]

Part (b) was also generally well answered by a number of candidates. Other candidates had no understanding of the term what 'visual inspection'. A few candidates provided incoherent responses to this question.

Exemplar 3

The manufacturer can look to ~~the~~ check for errors, like broken tracks, ~~the~~ improperly soldered components ~~and~~ or missing components.
Errors, like dry joints ~~can be~~ and bridges, can be seen.

This candidate clearly stated four visual checks that would be carried out on a commercially printed circuit board which gave a maximum mark of 4/4.

Question 5 (a)

5 (a)* Discuss the function and applications of a Liquid Crystal Display (LCD) module.

.....

.....

.....

..... [6]

A number of candidates answered this question with many giving a reasonable discussion of the function of a Liquid Crystal Display module. The applications named by candidates were wide ranging. A popular answer for the application of an LCD was a watch or clock.

Candidates who did less well on this question did not give a very sensible discussion, often producing incoherent responses 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 has not improved in this series. In a number of cases the quality of handwriting was poor, making responses appear incoherent and difficult to follow.

Question 5 (b)

(b) A typical seven segment LCD module is shown in Fig. 1.

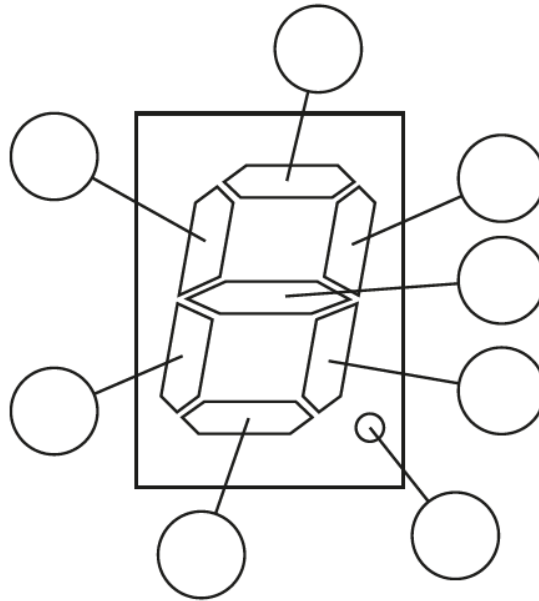


Fig. 1

Label each segment shown in Fig. 1 with the correct letters **A** to **G** and **DP**.

[4]

Part (b) was generally well answered by a number of candidates. Other candidates gave incorrect labelling with a few not even using A to G and DP as requested from the question.

Question 6 (a) (i)

6 (a) Fig. 2 shows a linear integrated circuit (IC).

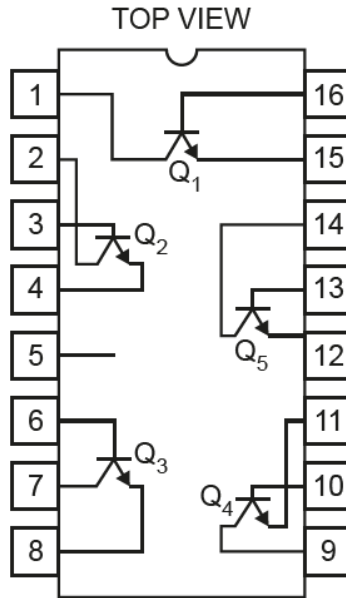


Fig. 2

(i) State the name of the component shown at positions Q₁ to Q₅ in Fig. 2.

..... [2]

While the correct answer to this question is 'npn transistor' a high proportion of candidates answered this question incorrectly. This is a little disappointing given that transistors are a required topic point in the unit specification.

Question 6 (a) (ii)

(ii) State the name that is given to the group of components arranged as shown in Fig. 2.

..... [2]

The correct answer for this part of the question is 'transistor array' but a high proportion of candidates answered this question incorrectly. Again, transistor arrays are an explicit point in the unit specification, and so lack of correct responses demonstrates possible lack of understanding of aspects of the specification.

Question 6 (b)

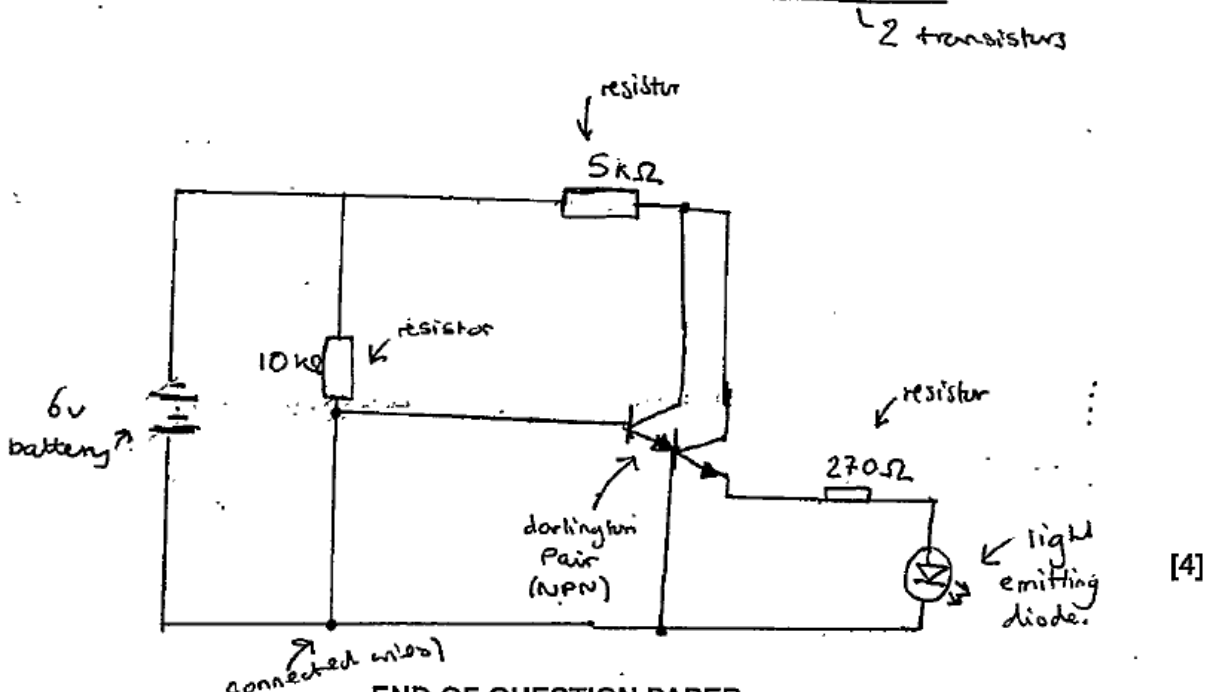
(b) Draw a labelled diagram that shows the connections for a Darlington Pair.

[4]

A number of candidates produced a reasonable diagram of Darlington Pair using correct labels for the shape of transistor, identifying the transistor, connecting the emitter to the base and connecting the collectors together. Other candidates had limited knowledge of what a Darlington Pair looked like and produced drawings of various incorrect circuits.

Exemplar 4

(b) Draw a labelled diagram that shows the connections for a Darlington Pair.



[4]

This candidate produced a very nice diagram of a correctly drawn Darlington Pair.

One mark was deducted because the candidate did not label the diagram with base(b), collector(c) and emitter(e). This resulted in a final mark of 3/4.

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