GCSE EXAMINERS' REPORTS

GCSE (NEW)
ELECTRONICS

SUMMER 2019

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ELECTRONICS

GCSE (NEW)

Summer 2019

COMPONENT 1: PRINCIPLES OF ELECTRONICS

General Comments

The paper worked well with the full range of marks from 0 to 80 being achieved by candidates. The mean mark for the paper was 52.41 with standard deviation of 22.99. Candidates generally attempted most questions with very few being omitted entirely. There was considerable evidence that candidates were unable to recall equations that were not provided in the information pages.

Comments on individual questions/sections

Q.1 (a) In part (a)(i) a number of candidates did not achieve any marks on the logic IC diagram to identify pin 6. Parts (ii), (iii) and (iv) were answered well by the majority of candidates.

(b) In part (b) a number of candidates were unable to identify the correct logic gate from the truth tables provided. Surprisingly quite a few candidates gave the answer of a NOT gate, even though in both (i) and (ii) the truth tables showed two inputs (A and B). Some candidates that did not identify the correct logic gate, did follow through their answer by drawing an appropriate logic gate symbol that matched the named gate for an e.c.f. mark in each case.

Q.2 (a) In part (a) completion of the table was generally correctly answered by candidates. A minority of candidates proceeded to fill every available box in the table, often making up their own subsystems to complete the table fully. A very small number of candidates made no attempt to complete the table even though the required subsystems were provided on the paper.

(b) In part (b) a significant number of candidates did very well and provided a complete solution and scored full marks. A smaller group of candidates failed to score any marks with the sections of the block diagram being filled with random subsystems from those provided with what appeared to be no understanding of the specification or how to build a system using the block diagram approach. A common error was to select the Thyristor as the output driver.

(c) In part (c) most candidates achieved 2 out of the 3 marks available. The vast majority of candidates understood that the monostable pulse should start with a 0-1 transition at 1 second, and that it is an instantaneous rise. The most common error was to end the pulse at the 3 second mark, instead of the 4 second mark and therefore a mark was lost. A minority of candidates gave an astable / clock output, or a sine wave and scored no marks.

Q.3 (a) In part (a) around 75% of candidates correctly identified circuit B as having the lowest resistance.

(b) In part (b) a small number of candidates made drawings of networks containing three resistors despite the question stating only two resistors. A small number also provided no terminals to provide the input and output of the network required. In each of these cases no marks were achieved. Only a small number of candidates attempted to calculate the final resistance which may account for the incidence of a number of incorrect pairs of resistors connected in parallel.

(c) In Part (c)(i) a number of candidates chose to omit the units on their numerical answers resulting in the loss of marks. Many candidates had no idea how to determine these numerical values indicating a lack of understanding of the rules regarding current and voltage in circuits. In part (ii) the lack of understanding of units was again obvious as candidates chose the wrong voltage, and/or current to provide a variety of incorrect answers. If candidates correctly wrote down the formula and rearranged it correctly they were able to gain some marks.

Q.4 (a) Part (a) was poorly answered, with a significant number of candidates unable to identify the thermistor as the component required for the sensor in the circuit. Most gave the answer 'temperature sensing unit'.

(b) For part (b)(i), a significant number of candidates made no attempt to complete the circuit diagram. Many candidates seem to have missed the questions required an answer to be drawn on the diagram. For those that did attempt the question most had the orientation correct for two marks. A smaller number of candidates gained one mark for a correct sensing network with the incorrect orientation. In (b)(ii) very few candidates were able to explain the purpose of the variable resistor being to change the reference voltage and therefore temperature at which the LED should switch on. The most common incorrect answer was to alter the brightness of the LED.

(c) In part (c) candidates were expected to recall and use the formula $P=I^2R$. Many candidates did but failed to deal with the fact that the current was in mA, often showing 302 = 900 completely ignoring the mA part of the number. Some tried to convert this to Amps, giving the incorrect answer of 0.3 A instead of 0.03 A. A small number of candidates tried to use $P=V^2/R$, using the incorrect voltage from the circuit supply voltage showing a misunderstanding of the question and the circuit operation.

(d) (i) In part (d)(i) approximately 60% of candidates were able to recall and use the equation V=IR and apply it to gain the answer of 9.9 V. Some candidates generated voltages in excess of the 12 V supply voltage, yet they did not seem to have any inclination that their answer was incorrect. This was due again to a lack of understanding that a mA is 1/1000 A.

(ii) In (d)(ii) most candidates were able to determine the voltage across the LED if they were successful in part (d)(i). Many candidates possibly suspecting an incorrect answer in part (d)(i) did not attempt to solve this using the formula V_{LED} = 12 - 'answer (d)(i).

(iv) In the final part (d)(iv) of this question candidates needed the solutions to (d)(i) and (d)(ii) in order to determine the correct LED would be the yellow one. Many just gave the high efficiency Red LED without any answers to (d)(i), and (d)(ii).

Q.5 Part (a)(i) was answered well by the majority of candidates. Part (a)(ii) was answered well by many candidates but quite a few used the AND operator instead of OR, giving the answer as $\overline{A.B}$ instead of $\overline{A+B}$. The final part of this question was poorly done with a significant number of candidates giving the answer $X+Y$ instead of the correct answer $\overline{C}+\overline{A+B}$. An e.c.f mark was available for candidates that correctly linked an incorrect (a)(i) or (a)(ii) provided that the Boolean was correct.

Most candidates scored 2 out of the 3 marks in completing the truth table. Column for 'Y' with the output of an OR gate instead of NOR was the biggest error for candidates. An e.c.f. mark was available if the 'Q' output was completed correctly from an incorrect 'Y'.

In part (c)(i) most candidates were able to convert each logic gate into its NAND gate equivalent and scored full marks. A minority of candidates were unable to convert even the NOT gate into the NAND equivalent and scored no marks.

Depending on the success of candidates in part (c)(i) it was possible that the circuit drawn did not have any redundant gates and therefore no marks were obtained. Even when the circuit was completed correctly a number of candidates failed to identify the correct NAND gates that were redundant. For some candidates this question posed no issues and they scored full marks.

Q.6 (a) In part (a) candidates needed to recall the formula P=IV, which for most candidates was not an issue. A few of these were then unable to convert the 500 mA into Amps giving the answer of 4500 W which did not seem to alarm the candidates as being just a little on the large size for a small motor.

(b) (i) In part (b)(i) most candidates were able to select the correct equation, however errors were made rearranging the equation and substituting the correct values of I_C and H_{FE} into the equation. This resulted in incorrect answers often with the wrong or missing units.

(ii) In part (b)(ii) a significant number of candidates were unable to determine the voltage across the 1.2 kΩ resistor because of an incorrect answer to (b)(i) and in some cases no attempt was made with this part of the question.

(iii) In part (b)(iii) the majority of candidates that attempted this part subtracted 0.7 V from their answer to (b)(ii) instead of adding it and therefore lost a mark.

Q.7 This question required candidates to evaluate a given solution to a problem. Whilst a significant number of candidates made a very good attempt at evaluating the solution, many candidates used up large amounts of their answer suggesting ways of improving the program without even mentioning what the program actually does in terms of the original specification. Careful consideration of the question should have revealed that no requirement to suggest more efficient solutions were required.

A full range of marks was obtained by candidates, but many did not evaluate the specification against the design.

Q.8 (a) (i) In part (a)(i) the majority of candidates were able to read the resistance of the LDR from the graph. A minority, however, did not read the units as kΩ, from the label on the axis giving the incorrect answer of 250.

(ii) In (a)(ii) candidates generally selected the voltage divider formula, however many used the incorrect 62.5 kΩ resistor value in the numerator, and / or introduced the value of 200 into their solution which was not even a resistance value. With a range of numbers to choose from a number of candidates lost marks on this part of the question as they failed to determine the correct value of V_{OUT}.

(b) Part (b) was effectively a fifty-fifty question in determining the effect of increasing the light level on the sensor. A significant number could not rationalise the change in the circuit and the effect this would have on V_{OUT}. Whether this was due to a misunderstanding of the LDR characteristic, or the operation of the sensing circuit was unclear.

(c) (i) In part (c)(i) most candidates were able to select the equation from the front of the paper but that was where the solution stopped for many. There seemed to be a misunderstanding of what values to use in the equation, and how to rearrange this with the (VGS – 3) part of the equation causing several issues. A minority of candidates completed the question without difficulty.

(ii) In part (c)(ii) only a minority of candidates were able to correctly complete the circuit diagram. Many candidates were unable to draw the correct symbol for a MOSFET.

Summary of key points

- Candidates need to be aware not all questions require a written response, but may require additional work on part completed diagrams, or graphs.
- Candidates should be able to use common scientific equations that are not provided in the data sheet, e.g. V=IR, P=IV, $P=I^2R$ etc.
- Candidates should check if an answer is realistic, e.g. the voltage across a resistor is unlikely to be 9900 V, when the power supply is 12 V.
- Candidates need to provide appropriate units with their answers to calculation.
- Candidates should start ‘Evaluate’ questions with a detailed comparison between the specification and the given design.

ELECTRONICS

GCSE (NEW)

Summer 2019

COMPONENT 2: APPLICATION OF ELECTRONICS

General Comments

The paper worked well with the full range of marks from 0 to 80 being achieved by candidates. The mean mark for the paper was 42.86 with standard deviation of 23.6. Candidates generally attempted most questions with very few being omitted entirely. There is some evidence that candidates are unable to handle standard multipliers especially ‘µ’.

Comments on individual questions/sections

Q.1 (a) In part (a) the majority of candidates were able to correctly locate the given instructions into the program boxes. Only very few candidates failed to do this correctly.

(b) In part (b) however, many candidates either made no attempt to complete the missing links or made the links to the wrong part of the program. Many candidates made these links back to the start so that the next instruction was to reset the counter, therefore ensuring that the program would never exit.

Q.2 (a) In part (a) the majority of candidates scored two of the three marks available for this question; continuing the 5 V output to the trigger point and then dropping this immediately to 0 V. The issue was with the final part of the graph which needed to show a charging curve for the capacitor. Many candidates showed a digital rise, or a linear increase both of which gained no credit.

(b) (i) In part (b)(i) candidates made a number of errors in determining the resistor value needed to produce the delay of three minutes. Some candidates did not locate the correct equation and scored no marks. Even when the correct equation was chosen, there were two further issues that cost candidates marks. Firstly, some candidates were not able to rearrange the equation correctly leading to incorrect answers. Secondly, many candidates were unable to convert three minutes into seconds, and/or deal with the ‘µ’, multiplier again giving incorrect answers.

(ii) In part (b)(ii) candidates were told that the answer in (b)(i) was not part of the E24 series, but many candidates insisted the solution was to choose the next highest value in the E24 series and gained no mark. Another significant number suggested a variable resistor which was insufficient to gain the mark. Candidates were required to state that the variable resistor needed to be adjusted to the correct value to ensure that the delay would be for exactly three minutes. Only a small minority of candidates provided a suitable explanation for this.

Q.3 (a) (i) The circuit diagram in part (a)(i) was completed incorrectly by a number of candidates. It was quite common to see an inverting amplifier circuit drawn instead of the required non-inverting amplifier. The standard of drawing was generally poor, rarely drawn using a ruler and/or pencil, candidates should clearly indicate when wires are connected with the use of a ‘dot’ at the junction. Too many diagrams had a maze of lines in ink that had been crossed out several times making it hard to understand which lines were intended answers to the question.

(ii) In part (a)(ii) most candidates chose the correct formula and were able to determine the correct ratio of 34:1. Suggested values of resistors were generally in the correct ratio, but a minority of candidates failed to ensure that both resistor values were >1 kΩ.

(b) (i) In part (b)(i) candidates drawing skills were again tested when asked to produce the output graph from the amplifier. In the main, candidates were able to sketch a correct non-inverted output signal, with reasonable frequency accuracy. Where candidates were unsuccessful was in determining the peak amplitude of 10.5 V. This element of the output graph was rarely seen in candidates’ answers.

(ii) In part (b)(ii) many candidates reproduced the same graph as provided in part (b)(i). Once again there was very little evidence of any calculation of the peak output, and the concept of saturation at ±13 V had been missed completely as a clipped output graph was rarely seen.

Q.4 (a) Part (a) was completed successfully by the majority of candidates.

(b) Part (b) was not completed well as candidates often left this part of the question blank. Candidates need to know that a ‘decoder’ is used for any logic system that interfaces between a signal and the output display, and that if a segment of a display is always on it should be connected to the positive supply, and if it is always off it should be connected to the negative supply. Decoders are not limited to linking BCD counters to 7-Segment displays, this is just a specific decoder for that function.

Q.5 (a) Parts (a)(i) and (ii) were either done well or incorrectly. Some candidates mixed up the ‘+’ and ‘.’ operators, presenting many variations of incorrect answers in terms of a Boolean expression for the Red and Yellow outputs.

(b) (i) Part (b)(i) was omitted by many candidates, possibly due to not actually realising it was a question since there was no space for an answer signified by a row of dots, the answer needed to be drawn on the diagram. Of those who did attempt the question there were a wide variety of connections made, many of them incorrectly linked to the outputs Red, Yellow, Blue and Green. This indicated a lack of understanding of the circuit and the need to reset the counter from its outputs ABCD.

(ii) Part (b)(ii) was completed well by most candidates. A small number of candidates did not attempt this question which is unusual, especially as the blue and green outputs only required the NOT of outputs B and C respectively.

Q.6 (a) In part (a) candidates needed to explain that a Schmitt was required to provide two different switching points so that minor changes in light level did not cause the street light to switch on and off repeatedly for shadows crossing the sensor for example.

(b) (i) In part (b)(i) most candidates were able to gain some marks and the majority realised that the output should start at 6 V to signify the inverting action. Some candidates did not apply the trigger points for the transitions between 1-0 and 0-1 correctly. This was best done when candidates used a ruler to draw the threshold levels on the top graph and then draw vertical lines downward when the transition conditions were met. This gave very little opportunity for error. The final mark was for having the correct saturation levels which was completed well by the majority of candidates.

(ii) In part (b)(ii) a number of candidates did not provide the times for the switch on/off of the street lights. E.c.f. marks were available for candidates that had incorrect switching levels but correctly gave the times from their graph in (b)(i).

Q.7 (a) (i) In (a)(i) approximately half of the candidates correctly identified the correct formula to determine the ratio for the mark/space. A few candidates provided the answer as 5.7, instead of 5.7:1 and lost a mark. Very few candidates calculated the Mark time and Space time and then the ratio between these two times. This is a valid approach but involved a lot more work for the candidates. It would be worth showing candidates the slightly easier method of determining this ratio.

(ii) In part (a)(ii) candidates found the frequency calculation difficult. Many were able to select the equation from the information page, but substitution of the correct values into the equation caused many issues. The incorrect use of standard multipliers, i.e. kΩ, and μF caused significant issues resulting in many incorrect answers for the frequency.

(b) (i) In part (b)(i) the majority of candidates were able to complete the table correctly. A small minority continued to complete rows 8 and 9 despite the instruction to reset the counter at output 7.

(ii) In part (b)(ii) a significant number of candidates were unable to configure the outputs using OR gates and the relevant counter outputs. Many candidates simply connected the counter outputs directly to the outputs without the use of logic gates. Only the Green output can be connected directly to the counter as it only comes on once.

(iii) In part (b)(iii) success was limited to a small number of candidates as a number of steps were required. Initially the frequency from (a)(ii) was needed to determine the period using 1/f. Having determined the period, candidates still had to realise that the Blue output was on for two periods during a complete sequence, so the final answer is double the period. This was a demanding part of the question which needed candidates to put a number of different skills into practice and was a good differentiation question.

Q.8 (a) In Part (a) most candidates were able to identify two of the three blocks in the amplifier system. The most common error was to lack detail in the answer to clock 'C', giving the answer as 'amplifier', which was not specific enough as 'Power Amplifier' was required.

(b) Part (b) was similar in performance to Q3(a) where the quality of circuit diagram drawing was poor. A summing amplifier was required based on the inverting op-amp. Most candidates achieved 1 or 2 marks but very few correct summing amplifier circuits were observed. Candidates need to be able draw these circuits from memory.

(c) In part (c) only a small number of candidates were able to explain that the purpose of block C was to increase the current and/or power to drive the loudspeaker. A voltage amplifier here is not sufficient, as these are the pre-amplifiers from the microphones / instrument pickups.

Q.9 (a) Part (a) of this question required candidates to evaluate a given control system for an aquarium. Candidates generally identified some issues with the design and made recommendations for the changes needed to fully meet the specification. A full range of marks was obtained by candidates, but many marks were lost by candidates not clearly comparing between specification and design which was required before explaining changes to meet the specification if required. Candidates will not always be asked to improve / modify the design, so they must read the question carefully so that they do not waste time giving irrelevant information.

(b) In part (b) many candidates were only able to select the correct equation. A minority of candidates completed the question without difficulty.

Summary of key points

- Candidates need to be able to draw standard circuits for inverting / non-inverting / summing amplifiers.
- Candidates need to understand how to use multipliers such as kΩ, and μF in equations.
- Candidates need be able to rearrange equations that contain bracketed terms, for example $I_D = g_M (V_{GS} – 3)$.
- Candidates need greater understanding of the role of links in flow charts to ensure that they feed back to an appropriate part of the program and that this is not always the start.

ELECTRONICS

GCSE (NEW)

Summer 2019

COMPONENT 3: EXTENDED SYSTEM DESIGN AND REALISATION TASK - NEA

General Comments

Centres are to be congratulated for their effort in presenting candidates' work for moderation, including the online recording of centre marks.

The assessment of the work was within tolerance in the vast majority of centres but in a small number of centres adjustments to marks were required.

In the majority of centres candidates produced a very good range of projects. Some of the work was outstanding and demonstrated considerable innovation. A small number of candidates attempted tasks based initially on complex circuits and consequently, they found it very difficult to identify and develop their system as a series of sub-systems.

Most of the photographic evidence was good but some photographs were too small to identify the necessary circuit detail.

A significant minority of centres did not provide any annotation of candidates work. Annotation on the scripts and/or mark scheme would greatly aid the moderation process. In particular an indication on the mark scheme of which level descriptors were or were not achieved would be very helpful.

Comments on individual questions/sections

System Planning

In several centres all candidates' work seems to have focused on a common theme. Candidates should focus on a problem to analyse to enable them to write a design specification based on an individually identified problem. This is expected to produce a wide range of tasks within a centre.

Design specifications should contain a range of both qualitative and quantitative terms based on their analysis of the problem and contain detailed realistic electronic parameters. The type of logic gates or resistor values to be used should not form part of the quantitative specification. The choice of a particular component may be part of the design solution to a problem but not part of the specification.

In some centres, candidates seem to have put a great deal of effort into providing information that earned them very little marks. For example, much of the research involved candidates replicating identical and complex alarm circuits which were outside their experience. This research was not put to any use. Many candidates provided multiple images of input and output devices that were not required for their design.

System Development

The block diagram for the proposed system can be modelled using systems boards or a systems simulation package. This will allow candidates to modify their initial design to achieve their specification.

Once the final system block diagram is finalised, the emphasis should then be on building and testing individual sub-systems which can then be interconnected to form the complete system.

Many accounts provided for the sub-system testing tended to be observational with limited account of the testing that took place. For each sub-system a test reading should be provided with the output activated and non-activated.

Test results obtained from circuit simulations are only valid if real components such as LM741 or BC548 are chosen rather than the generic IC1 and Q1.

When using a flowchart program, simulation tests should be carried out for the program and include screenshots of the results. There is no benefit in downloading a program to a microcontroller until the flowchart is performing as expected.

System Realisation

On the whole, the physical circuit layout produced by candidates was of a good standard, with the vast majority of the work constructed on breadboard.

As with the sub-system testing, the account provided for the complete hard-wired system testing tended to be observational with limited use of test equipment. The recording of test results tended to lack detail. Much of the analysis of the results was superficial.

To access the full range of marks for system realisation candidates should:

- use appropriate test equipment,
- record and analyse numerical results.

Evaluation

A consequence of not having any measurable parameters in the specifications resulted in a significant minority of candidates providing very simplistic evaluations.

The evaluation should compare the system against the design specification and make suggestions for improvement to access the full range of marks.

Many of the suggested improvements were either superficial or impracticable. Suggestions for improvement must be relevant and make it clear why incorporating such an improvement would be beneficial.

Summary of key points

- Candidates should focus on a problem to analyse to enable them to write a design specification based on an individually identified problem. The analysis of the problem should include a range of qualitative and quantitative criteria for the design specification.

- Candidates do not need to provide copies of research carried out. Marks are only gained for the analysis of the problem leading to the design specification.

- Details should be recorded of sub-system tests (including flow-chart programs) with results of the different states of its operation.

- Ensure when simulating circuits, only valid if real components are chosen rather than default generic simulation components.

- When testing the full system candidates should use appropriate test equipment, record numerical results and analyse the results against the specification.

- Candidates should compare the system against the design specification and make suggestions for improvement which must be relevant.

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