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Electronics 44301

(Specification 4430)

Unit 1: Written Paper

Report on the Examination

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General Comments

This is the second year of the new specification in GCSE Electronics and now candidates have had the opportunity to prepare this year using the previous year's past paper and also the specimen paper, not to mention the previous specification past papers which are still useful. Much has been changed from the previous specification in terms of the arrangement of assessment units, but the subject content and the style of questions have however been retained since the subject matter itself has seen little change and is well understood and practised by most teachers teaching this course.

The content of this year's paper follows the pattern set by last year's paper and the specimen paper, where the first five questions are short answer questions primarily aimed at the lower ability candidates, but still containing material that will make all candidates think; this is then followed by longer more searching questions, which although aimed at the higher ability candidates, contain sections of higher accessibility. In this way, a paper is created that meets the requirements of the specification that would also look familiar to those candidates who had prepared well for this examination by practising on past papers. This style and content will continue for the foreseeable future.

The length of the paper and the mark total continues at 2 hours and 150 marks. This is intended to give all candidates enough time to complete their answers to the paper including time for reflection on the higher level questions. The benefit of the single paper is that there is no need to decide on the appropriate tier of entry for each candidate. The outcome continues to be successful in that there were very few candidates who scored very low marks, more than 95% of candidates gaining more than 25 marks, and at the other end of the spectrum, although a few candidates did gain near maximum mark totals, there was not a large group of candidates at this level, demonstrating that there was adequate challenge in the paper for high ability candidates. The overall distribution of the marks continued to be very wide indeed.

In conclusion, virtually all the candidates this year again seem to have found plenty that they could attempt on the paper. The length of the paper seemed to be appropriate to the time required to answer it for most candidates, there was little evidence of unfinished questions towards the end of the paper but rather that most candidates were prepared to have a go even though they could not provide a valid answer, rather than unanswered questions possibly indicating that they were running out of time. It is also pleasing to note that this year; candidates gaining a grade A on the paper were scoring a minimum of 80% of the marks, evidence of real achievement.

Question 1

This question was about electrical safety and included a fuse selection problem. This year there seemed to be an improved awareness of the dangers of mains electricity and safety issues, which is a good thing.

(a) Generally this was well answered with over a third of candidates receiving full marks. A reference to first aid was the most common omission leading to only 2 marks being awarded. A significant number of candidates gave switching off the supply and removing the victim from the supply with an insulator (usually a broom handle) as separate points. Some candidates thought the victim should not be touched under any circumstances or that water should be removed from the area.

(b) Again this was often well answered with detailed and accurate responses. Some candidates omitted burns and their description (losing marks) and instead gave more examples of the effect of shock. Many medical details were not precise enough to be given the mark.

(c) This was very well answered by most candidates – the correct formula was seen to be used and a correct answer obtained and then given the correct unit. Some omitted the unit and a few gave Ω. Some divided 230 by 1000 and a few of them then chose the 1 A fuse. Some multiplied 230 by 1000 and made a random choice of fuse.

Question 2

This system based question again followed a long-standing pattern from the previous specification and even before that. It provides an accessible question that embodies the essence of the specification, a systems approach to electronics.

(a) This was well answered with the vast majority of candidates gaining at least 2 marks for the first two parts. The latch in part (iii) was found the most difficult subsystem to name as a memory – comparator or OR gate were offered instead, but still two thirds of candidates answered this correctly.

(b) Again there were many perfect answers. The audible warning device was identified by nearly all (95%) candidates and the latch in part (i) for the D-type flip-flop was found most difficult – “OR gate” and “driver” being the common incorrect responses.

(c) Mostly correct answers were noted here. The OR gate was chosen by nearly everyone as an example of logic. (A very small number were given credit for choosing the latch.) The comparator was found a little more demanding. The driver was the most common incorrect response along with other apparently random choices.

(d) There were many detailed answers here. More able candidates explained the operation of the OR gate and the latch in terms of highs and lows (or 0 and 1). They explained the operation of the driver as boosting power or current. More than 50% of candidates gained full marks here.

Weaker candidates answered without using the terms high and low (0 and 1) and lost a mark. They wrote of “signals” being sent to the OR gate and then to the latch. They did not explain the function of the driver when it already has a high voltage at its input. A very small number were confused and thought the alarm would not sound at all. Candidates did not have to cover all of this detail to obtain the 2 marks but reasonable evidence of understanding some parts of the system was required.

Question 3

The response to the logic question here was again good; leading the question with the application helped many as it did last year.

(a) Most candidates could suggest a transmitter and receiver. (Alpha particle source /GM tube was rare but allowed.) Weaker candidates struggled and there were several blank spaces. A few suggested pressure sensors or weight sensors. Part (iii) was often well answered and some candidates who had failed or not attempted parts (i) and (ii) gained the mark.

A small number of candidates thought the sensor was inside the box. Several candidates brought in the resistance of the LDR and the effect of the light beam on it. This was not needed. If they had also described when the beam would reach the sensor then resistance was not relevant. Generally those who relied on the state of the resistance for the mark, because of the way they had answered, were correct in their description of how it changed.

(b) In part (i) The vast majority of candidates gave the correct answer, and in part (ii) most were able to draw a recognisable AND gate. A significant number did not label the inputs though some of these candidates did label the output.

In part (iii) nearly all could complete the truth table for an AND gate.

Question 4

This question on the 555 timer and the D-type flip-flop met with a mixed response that became less and less successful as the question progressed generally.

(a) In part (i) this question produced responses of variable quality: neat and accurate, untidy (but adequate to locate components and gain full marks), with one or two errors, untidy with apparently random positioning of components and a few not attempted. Several candidates lost marks for not labelling the resistors and/or joining the threshold and discharge connections instead of trigger and threshold. The diagram for an astable is asked frequently in one form or another and had been learnt well by many. Overall, just over 50% gained full marks here.

Part (ii) also produced a spread of marks. This calculation is one of the most demanding set on the paper and there were many correct answers with correct units. Just over a third gained full marks here. Candidates were asked to show working and most did, so it was possible to give credit to many of those who did not obtain the correct answer. Substituting 0.01μF in the formula caused difficulties for several. Some candidates ignored all the prefixes – kΩ(twice) and μF. In addition, some did not multiply R_2 by two.

(b) The D-type flip-flop was named correctly by many but did not seem to have been covered at some centres. Answers of “frequency divider” could not be given credit as this was given in the question. More candidates were able to draw in the correct connecting wire. Only around 40% of candidates could gain these two marks.

(c) In part (i) correct answers were seen but this was not known by an appreciable number, some 60% of candidates missed out here. Some left blanks and some gave answers such as 4017, 555 etc.

In part (ii) more gave correct advantages, but “simpler” and “more efficient were not given credit as they are not sufficiently specific.

Question 5

This question met with a mixed response. It seems that knowledge of the MOSFET is not as widely shown as it ought to be.

(a) The type of component recognised as the MOSFET resulted in 70% of candidates gaining the mark here, but the labels were only given correctly by less than 40%, who had learnt this diagram. Some confused the drain and source. A few used a mix of labels including base collector and emitter from the bipolar transistor in random positions.

In part (iii) the diode was drawn in the correct position by many (including some who did not gain any marks on parts (i) and (ii).) Nearly all who drew a diode gave the correct orientation. A significant number drew in a resistor which was quite often positioned in the gate lead. Only some 40% of candidates scored all three marks here.

(b) In part (i) a few candidates multiplied but the vast majority (over 80%) divided and obtained the correct answer to which they gave the correct unit.

In part (ii) mostly correct answers were seen (13 A was common and allowed). A few gave a number with an incorrect unit – often Ω - which was not allowed.

Question 6

Flowchart diagram questions continue to be a feature of Electronics examination papers. This year candidates have again demonstrated knowledge and understanding in gaining high marks including the flowchart design in part (c).

(a) Most candidates scored some marks and nearly 60% obtained full marks for this question. Few did not attempt it. Identifying the last box as a process box was found quite difficult by some. There were a small number who did not seem familiar with flowchart symbols.

(b) Over 50% of candidates scored full marks here. Four was a common mark for those who labelled the process box elsewhere. Three was a common mark for those who labelled the last box “output” so had to use “process” elsewhere. Nearly everyone could identify a loop and a decision box. There were a few who labelled boxes which said input inside them as outputs.

(c) To gain full marks candidates needed to produce a logical flow chart covering the main stages in the process described. Some details could have been omitted and generally a minimum of eleven or twelve boxes were needed to achieve this. Many excellent and detailed flowcharts were seen which exceeded this minimum requirement. Nearly all candidates attempted to answer but some found it difficult and omitted important stages or did not follow a logical progression and obtained less than the full mark allocation. In this question it was important that the flow chart branched for cash or card payments and some candidates ignored one of these branches. Generally in assessing a flow chart it is pleasing to see a “display cash or card” output statement followed by an “input screen sensor” statement before there is a decision box. Frequently such input statements are omitted. (In this example candidates could still obtain full marks without every input statement being included). It was pleasing to see that nearly a quarter of all candidates scored full marks here, and over 70% got half marks or more.

Question 7

This was the second of the longer more searching questions on the paper, although the accessibility was much at the same level as the preceding question the response was at a lower level. The topic of radio still does not attract as much attention as it should.

(a) Generally this simple introductory part had been answered well. Aerial was generally found easier than demodulator by those who scored one out of the two marks.

(b) Correct answers were given by fewer than 50% of candidates. Those who did not obtain marks were usually too unclear in their meaning but other totally wrong answers were responses such as “to convert analogue to digital”.

(c) 20 Hz was the most common answer, given by nearly 60% of candidates. There were a few widely wrong responses – in the kilo or megahertz regions.

(d) Parts (i) and (ii) were known by a majority here - a few blanks and some “analogue modulation”, “amplifier modulation” and “audio modulation” were noted and not given credit.

In part (iii) some carefully drawn diagrams with construction lines to show the envelope of the AM and the constant amplitude of the FM were seen. Many diagrams were so untidy that marks could not be awarded for constant amplitude. A significant number doubled the frequency of the modulation signal in their diagrams, particularly for the amplitude modulated carrier wave, and lost the phase marks. Only some 20% of all candidates gained full marks here.

(e) This part was generally found difficult (less than 40% gained full marks in either part here), but several good answers were noted.

Question 8

This question, ranging over logic and op-amp design and ending in a practical component layout as last year was aimed at the higher ability candidates with some more accessible sections to provide material at a lower level. Responses were variable as expected.

(a) This was completed successfully by many but by no means all. Some obtained only one mark for the easier first column.

(b) Part (i) was not known by a significant number bur correct for the majority (some 70%). A few examples of a candidate changing their mind was seen, leaving a zero with a one through it and consequently making it not clear which is the final answer – so credit cannot be given.

In part (ii) it was pleasing to see this more challenging question answered so well. Most who knew the truth table for a NOR gate were able to apply their knowledge. Several scored one for the easier first column. A few scored one for the last column only – presumably worked out from the sense of the question if not developed from the truth table.

Part (iii) resulted in many good answers gaining both marks. Some gave the main point that only one IC is needed but did not go any further. Credit was not given for non-specific answers such as “simpler” or “easier”.

(c) Part (i) was found challenging but over 30% gave correct answers. Working was usually insufficiently organised to give credit if the final answer was wrong.

Part (ii) was answered correctly by nearly all candidates (90%). The answer "30Ω" was penalised for having the incorrect unit.

Part (iii) was challenging but answered correctly by a significant minority, some 30% of candidates.

(d) Many correct answers were seen here, nearly 50% of candidates gaining full marks. Some lacked elegance but would work so were given full credit. Most candidates were very familiar with prototyping board but a few placed their resistor in a column of holes which were connected together internally. Several candidates did not attempt this question. Candidates who placed two wires in one hole (or a wire in with the pin of the IC) were penalised.

Question 9

Another longer question, focussing on an amplifier circuit and measurement techniques, including meters and an oscilloscope, contained a wide range of levels of difficulty and proved to discriminate well between candidates.

(a) Most candidates gained the first mark for "output" and many the last for "power supply" but the names of the two inputs were not well known. Some candidates attempted to explain what the inputs did but generally the comparing aspect was ignored and credit was not given.

(b) In part (i) some strange diagrams were seen for the wiring, less than 30% of candidates gaining full marks here. In part (ii), although getting towards the end of the exam the vast majority of candidates attempted this question and gained marks for it. Most also gave the correct unit.

In part (iii) nearly all candidates knew that the ammeter was the wrong way around. (A few thought the battery connections should be reversed and gained no credit.) Only the most able 10% were able to explain that the minus was to do with direction and that the magnitude of the current would not be affected if the ammeter was reversed. A small number thought it was to do with inverting inputs.

(c) In part (i) many correct answers were seen from the most able – clearly candidates found this difficult. Several candidates left the answer space blank here.

Part (ii) was again tackled well by the most able. Converting units caused no problems to some.

Part (iii) was found difficult by many but also good answers being produced, many were able to follow through from part (iii) to part (iv).

Part (v) saw some neat accurate diagrams but many drew far from recognisable sine waves and lost marks.

Part (vi) was the most difficult part. Some 30% were able to give the correct answer but also many who did not know which formula to apply or how to use it.

Question 10

This final, longest question was again pitched at the higher end of the ability range to provide challenge to candidates who were aiming for the top end of the grade range. It started with standard work on the 555 timer (which would have provided material for all candidates), then went on to some sophisticated work utilising the 4017 IC. There was also an opportunity for candidates to show their abilities regarding the quality of written communication. The question ended on a simpler vein which was well spotted by all candidates as an opportunity to complete the paper on a positive note.

(a) In part (i) many correct answers were seen. Some candidates overlooked the reset connection. Poor drawings of symbols were perhaps other signs of fatigue. Many weaker candidates were confused by the pull up resistor and lost marks by connecting it to the capacitor and discharge and threshold connections.

Part (ii) was generally found difficult but several detailed and accurate descriptions were produced. Many thought incorrectly that the input voltage to the trigger must go high. More stated correctly that a pulse was produced – some missed this saying only that the output goes high. Weaker candidates wrote about the buzzer sounding. Only a few stated the effect of R and C would have on the pulse length.

(b) In part (i) many correct answers but some connected the LED in series with the reset switch where it would only be lit while the switch is pressed. Some connected it to the reset pin. A surprising number connected it from Q_O to O V without a series resistor. (Many joined the LED to the existing 680 Ω resistor which was fine.) A few did not draw a reasonable symbol for the LED although there were many to copy from on the diagram they were looking at.

Part (ii) was found to be quite difficult. Weaker candidates just said the buzzer goes off or needs to be reset. A small number thought the LEDs went out in sequence. Many thought that as the LEDs came on they stayed on or left this uncertain. Many better answers explained that the LEDs came on in turn. Some answered in terms of the states of the outputs Q_0 to $Q_{5,}$ rather than the LEDs which were equally acceptable.

In part (iii) there were several blank spaces instead of answers but the great majority had a go at answering this difficult question. Only the most able obtained full marks but the complete range was awarded. Some only described how counting was stopped and did not address the pull down resistor. Some described only the function of the pull down resistor. Many thought the resistor was to protect the buzzer.

Part (iv) was attempted by nearly all candidates and most (over 70%) scored all three marks. Quite a few gained two marks having written black instead of brown for the multiplier band.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.