GCSE
ELECTRONICS

44301 – Written Paper
Report on the Examination

4430
June 2014

Version: 1.0

Further copies of this Report are available from aqa.org.uk

General Comments

This is the fourth year of this specification and candidates are able to benefit from past papers and the specimen paper as they are all in a similar style and format. The paper begins with short answer questions which are mainly straightforward and directed towards lower ability candidates but there are some challenging parts within them. Later questions are longer and some parts make considerably higher demands on candidates.

This year much work of a high standard was produced and there was evidence that as well as using past papers the specification had been used as a checklist and been covered thoroughly in many centres.

Most candidates appeared to be used to the style of question and understood what was required. Most work was neat and well ordered. Most candidates knew that in questions asking for a comparison a two-part answer was required with an implied “whereas” between them and that they should not make the assumption that the examiners know what they mean without it being written down. Calculations are generally carried out well and calculators used competently. If the final answer is correct then generally it is assumed, in this specification, that adequate working has been done. However, marks are available for showing working so candidates should be encouraged to give some explanation of what they are doing in case the final answer is incorrect. In calculations, sometimes the working out appears as unordered jottings and candidates should be encouraged to work from left to right and down the page. This is not always done and the answer can be hidden amongst previous failed attempts.
Most candidates do include appropriate units with their numerical answers and although their omission is not always penalised within every question it is desirable.
There is a general rule for the paper that a mark will not be given if a candidate gives the examiner a choice of two answers one of which is correct and the other incorrect. If candidates have made a second attempt they should make it clear which is their final answer. Most candidates do this. In longer answers where candidates give the correct answer but go on with additional incorrect but irrelevant information they are generally not penalised unless there is a blatant contradiction of what they have said already.
Most candidates know they will not gain marks for answers such as an amplifier amplifies or a demodulator demodulates as the words used are implied very clearly in the question.

The paper is long both in terms of marks and time. A large proportion of the specification is covered by questions each year. The spread of marks suggests that there is plenty accessible to less able candidates as well as much to challenge the more able. Most candidates seem to cope well with this and keep going, gaining marks where they can. There is little evidence that candidates give up and do not attempt later questions or that they have run out of time.

Question 1

This question concerned electrical safety as it has done for several years. Part (a) asked for rules which should be followed in an electronics laboratory and reasons for them. A variety of answers was given credit. Knowledge of PAT testing, handling chemicals for PCBs, wearing eye protection when soldering were all given marks. Some answers were too general and rules which would apply in all workplaces such as not sticking metal objects into sockets or running around were not given credit. Some answers were impractical such as turn off the mains at all times and have no bare wires. The answers in the mark scheme were the most common and most candidates obtained at least 3 marks.

Nearly all candidates obtained some marks for part (b). An explanation of the isolating transformer was only answered correctly by a minority. Many gave a general definition of the word isolating. There was some confusion with mains isolators. Some correct answers gave explanations in terms of magnetic fields and induction.
Most could explain the term step down transformer but some just said it "steps down" voltage without saying what this means. A few said steps down current.
Most obtained the mark for dc and those who gave additional incorrect information such as it is a steady or constant current were not penalised. "Digital current" was a rare incorrect answer. Most candidates obtained full marks for part (c) and many good explanations of how a fuse works were offered. Most knew the fuse should be in the live wire. In answering a question asking for a difference most candidates realised that an answer should have two parts: a fuse must be replaced but a circuit breaker can be reset. A few candidates gave an alternative answer such as a fuse is thermal and a circuit breaker is electromagnetic.

Question 2

Most candidates gained at least 5 out of 10 for this question but few gained full marks. The resistor was well known. For the 4013 marks were given for relevant information no matter which column it was written in. Some thought it was an op-amp or counter. The capacitor was found the most difficult with some not recognising it as such. To gain the mark for its value F or farads was required. Some offered joules for J and 100μF to explain the 100.

Question 3

This type of question is expected by any candidate who has worked through past papers and as in previous years was high scoring. Nearly all candidates gained full marks for part (a) but nearly half lost a mark in part (b). Where a voltage divider would be found was the most difficult.

Question 4

This question did not score quite as highly as question 3 but was again tackled successfully by most. Most candidates scored full marks for part (a) with a variety of errors accounting for the loss of marks. Part (b) was found a little more challenging. Some candidates were considerably neater than others. The weakest candidates had difficulty with basic symbols – two input NOT gates and one input AND gates were seen.

Question 5

Part (a) (i) Many correct answers using different formats were seen. Only a few candidates confused polarity.
In part (a) (ii) even more candidates identified "series" as the correct answer.
Part (b) Very many candidates followed the calculations through and worked from stage to stage obtaining full marks. Pleasingly in part (ii) most converted mA to A and obtained the correct answer. There were a few correct answers in kΩ. Part (iii) was the most challenging with most choosing the higher value but a considerable number just saying you must go higher without giving a reason. Some thought it was to protect the resistor from damage. In part (iv) most chose the correct value. "Error carried forward" marks were available but rarely used as most who knew enough to give an answer were also accurate. Part (v) was answered well by a large majority. Many resistors in parallel calculations were seen or valid explanations in words were offered.

Question 6

The flowchart question should be expected by all and was indeed very high scoring. Most knew the flowchart symbols with the process box being found most difficult. Again this year some candidates altered their diagrams and if it was not possible to tell which version was their final offering then credit was not given. In part (b) a very few thought the start box was an input. The most common reason (but still rare) for the loss of a mark was candidates thinking that any line out of a box was a loop. A few labelled the delay box as a loop. In part (c) there were many excellent answers and correspondingly high scores given. There were many excellent answers for part (c). The most common reason for losing two marks was the omission of the "are two fingers touching?" box. Some who included this did not know what to do with the "no" answer. A few weaker candidates were confused and wrote instructions to the user such as an output box with "move your fingers together".

Question 7

Just over 50% of candidates obtained both marks for part (a). The first box was the most difficult and "tuner" was not allowed as being equivalent to tuned circuit. Many candidates were well prepared for part (b) and had learnt definitions (but whether this is done or not does seem to depend on the centre). Answers included "convert e.m. waves into….", "transduce e.m. waves into…" , "radio waves induce ….". Answers such as "pick up signals and pass them on to the tuned circuit" did not receive credit as the terms "radio" or "electromagnetic" and "electrical" were required.
The function of the demodulator was learnt well by a substantial proportion of candidates but found difficult by others with almost half gaining no marks. Some had not learnt the definition properly and gave answers showing lack of understanding – "removes the carrier wave leaving the radio signal". Those who offered "demodulates the wave" gained no credit.
Some candidates described the function of a diode but did not gain marks unless they made it clear how this was relevant to the context.
The term frequency modulation was widely known.
Many candidates were given two marks for their diagrams of amplitude modulation in part (a) (v) but in many cases they were given "the benefit of the doubt" because their diagrams were not clear and neat. Spiky and blobby waveforms – far from a sine wave – were drawn. Extreme examples were penalised.

Part 7(b) Most candidates found the period of the signal and over half went on to calculate the frequency correctly. Nearly all who carried out an accurate calculation gave a correct unit. Some candidates benefitted from "error carried forward" marks in part (ii) and some gained marks having scored zero in part (i). Most could calculate the peak voltage.
Just over half of candidates could accurately name or describe the y-sensitivity control.

Part 7(d) (i) was the gain calculation and was known by many. A few used the equation upside down and 10 – 0.5 = 9.5 was another zero-mark answer. A significant number gave a unit (usually volts) for the answer but this was not penalised on this occasion. (One candidate gave 20 dB and was not penalised or rewarded for knowing that dBs have something to do with gain.)

Many could quote an equation for calculating the rms value and went on to obtain the correct answer. Some who quoted $\sqrt{2}$ had difficulty evaluating it. 20 was quite often used as the peak value. Missing the unit was quite common but not penalised on this occasion.

7(d) (iii) The better-prepared candidates had learnt a perfect definition of bandwidth and gained both marks. (Many gained 1 mark for knowing a range of frequencies was involved.) Most of the correct answers included a power gain of 50% of the maximum. Fewer gave 70% of the voltage gain. Where the type of gain was not specified, benefit of the doubt was given. Some candidates gave correct answers using both voltage and power gain.

Question 8

Part (a) It was expected that this part of the specification might be found difficult as it has not been covered widely before. Pleasingly it had been learnt thoroughly by some candidates - and others made a guess. Those who simply stated that the input resistance was higher than the output resistance were given one mark and those who included “much higher” gained both marks. Candidates who said the output resistance is zero were given the benefit of the doubt but more said it should ideally be zero. Some did not understand the question and gave the more often examined explanation of an op-amp as a comparator.
In part (b) (i) there were many correct calculations. The mark for working was rarely given alone as nearly all of those who could explain their reasoning obtained the correct answer. Occasionally an attempt to use ratios or proportions could be given one mark.
Parts (b) (ii) and (iii) were generally well known and answers giving the supply voltages were most common.

Part(c) (i) produced a wide spread of marks and a high discrimination index. Most candidates could name the connections. Many excellent symbols were drawn but as only one mark was awarded for the symbol less than perfect attempts were given the benefit of the doubt. Most candidates can only learn how to draw symbols by practising drawing them.

Part (c) (ii) was found to be difficult with few candidates gaining full marks. Many thought the diode was to protect the relay. Many thought the diode gave protection by blocking damaging current flowing because it was the wrong way round rather than stating that it provided a safe path. There were several examples of “voltage flowing”. Whether the induced emf is a forward or back emf was not made an issue. Some candidates thought that if there is a diode then there must be an ac current involved. Some candidates gave accurate descriptions of induction but followed this by stating the diode blocked the induced currents and obtained 4/5.

Question 9

Most candidates obtained full marks for the first truth table. Many candidates gave a precise answer to part (a) (ii) similar to that in the mark scheme which summarised the conditions. (Some missed the “or both” mark.) Some attempted to list all the combinations of inputs which would cause the alarm to sound. This is a long-winded approach and candidates often lost marks by not making it clear whether they meant a device was switched on or the logic level of the sensor was high.

Most candidates chose the correct output column for the NOR gate.

The truth table in part (b) (ii) was followed through successfully by many. It was partially correct for others but a few were out of their depth and a small number did not attempt this.

Part (c) There were many fully correct answers showing familiarity with prototyping board and/or previous papers. Surprisingly a small number did not attempt this question. Nearly all candidates

obtained the marks for the labels. Some overlooked the zero volts connection and a very small number lost a mark for showing two wires in one hole. Each year a few candidates ignore the prototyping board and draw an overlay of a circuit diagram on top of the board. This can gain one or two marks because connections go to the correct places but pleasingly fewer did this than in previous years.

Question 10

The name monostable was known by most and very few did not attempt to complete the circuit diagram. Many scored full marks. Many ruler-drawn diagrams were seen. Many freehand but quite acceptable diagrams were produced. Some were neat but with many alterations. Some benefit of the doubt was given to capacitors with plates of unequal length but where this was extreme they were penalised. (One or two candidates drew in batteries of cells instead of a capacitor.) A significant number lost a mark for not connecting the reset. Candidates did not need to remember that 555 monostables are triggered when the output goes low but some lost a mark for having the switch and resistor the wrong way round.

The name astable was also widely known and the circuit for this was completed well by most. A few omitted the capacitor. Some connected the series chain to reset and this was allowed.

Part (b) (iii) Well over half of the candidates gained full marks for the astable calculation, having kept track of exponents. (Some lost one mark for not doing this.) This question was not attempted by a few candidates but most could gain at least one mark for choosing the correct formula. A few tried to use the monostable equation.

10 (c) (i) There were many correct answers. Most candidates included 3 resistors but some used only one but connected correctly. Some missed out the protective resistors (it is to be hoped) because they knew they were optional with this IC and so they were not penalised. There were very few diodes the wrong way round but a few had arrows missing.

Part (c) (ii) At the end of a long exam most candidates were still going and still thinking clearly. Over three quarters gained at least four marks for this part and many gained full marks. The input trace was the main source of lost marks.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator www.aqa.org.uk/umsconversion