A-LEVEL
PHYSICS

7408/3BE Electronics
Report on the Examination

7408
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General Comments

There was a slight increase in the take-up of this option paper this year and it was clear that the resources for the unit produced by AQA had been used effectively.

Question 1

01.1 This question tested the ability of students to write a Boolean expression to represent a given logic circuit. The question was answered well (70% of students gained both marks) and most students opted for the algebraic version, although a few gave a written version which received equal credit. Future questions of this nature will probably be written asking specifically for the **algebraic** version.

01.2 This question tested the knowledge of truth tables for a range of logic gates and the ability to analyse a combinational logic system. Overall, the question was answered well, with 79% of students scoring two marks.

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01.3 This question was a little more demanding. A few students became side-tracked by expecting the manufacturer of the system also to make the logic IC's. However, most students were able to produce a viable answer based on cost and space. 86% gained at least one mark here. *Students should be shown a diagram of a typical 2-input logic gate arrangement on an IC, even if they do not use the IC.*

01.4 This was a straight recall question. Many students (79%) correctly identified the **Q** column in the truth table as being that of the exclusive OR gate.

Question 2

02.1 This proved to be a simple calculation for most students, with 84% gaining the mark.

02.2 Just under 50% of the students picked up maximum marks for correctly drawing the non-inverting amplifier. Although many produced the arrangement shown in the mark scheme, other arrangements of the resistor chain were accepted. However, a significant proportion of students (40%) were unable to score on this question.

02.3 The first mark here was given for identifying the correct formula and then for showing the resistor ratio to be 39. When faced with this information, it is always worth checking to see if using 1 $\mathrm{k}\Omega$ for the lower resistor leads to a sensible value for the top resistor. This produced the second mark. Most students scored well on this question, with 68% gaining both marks.

02.4 The best answers for this question came from students who appreciated that there would be a 50 kHz signal going into an operational amplifier having a gain-bandwidth product of 1 MHz, leading to a maximum gain of only 20. This approach comes from the question which asked candidates to: 'Discuss whether **this** operational amplifier is suitable…' 29% of students scored both marks. However, one mark was given if students got as far as showing that the operational amplifier really needed to have a gain-bandwidth product of twice that of the amplifier used in the circuit. The main error here was produced by

students thinking that the 50 kHz signal was being transmitted by an AM system wrongly leading to a total bandwidth of 100 kHz. *It will always be made clear in the question if AM/FM transmission is in use.*

Question 3

03.1 Only about 52% of students were successful on this question, but given the success achieved on the next question there was obviously a good general understanding of the radio transmission system.

03.2 A large proportion of students (82%) gained this mark.

03.3 'Attenuation across the transmission path' was accepted for the one mark, although it was good to see some students expand on this statement and give a reason for the attenuation.

03.4 A significant number of students (61%) failed to get this mark. The problem appeared to be with not knowing the AM shape rather than succumbing to any technical difficulties in drawing the shape.

03.5 Students found this question to be more difficult. Many forgot that this was an AM system and the broadcast frequency range had to accommodate the total bandwidth 2 x (f_m) for each station. Although a significant number of students still managed to argue (incorrectly) that not all stations could broadcast 20 kHz hi-fi, they failed to pick up the last marking point which was for stating what the consequences would be if the stations went ahead with hi-fi broadcasts across the full audio range. Only 19% of students scored all three marks.

Question 4

04.1 Most students found the calculation to be quite straight forward with very few '*power of ten'* issues. 84% arrived at the correct answer.

04.2 Just under half of the students (46%) were able to transfer the written properties from the stem into the voltage-time diagram.

04.3 A surprising number of students did not open with a statement to say that '*if the PRF is x4, then the effective R must be ¼ value'*. This should then have triggered a parallel resistor calculation as a means of adding a resistor to reduce the total resistance. 50% of students gained at least one of the two marks available. *In general, it is important that multi-step calculations are carefully set out and explained to make sure that students can target all marks.*

04.4 This question proved to be quite demanding and required students to pull in information from a number of areas. The key was to appreciate that the t_C = ¾ T and t_D = ¼ T
For many, the calculation evolved without a clear plan. However, one mark was available for making significant headway towards the solution. Only 24% of students gained both marks here.

04.5 The graph was generally drawn well, although still only accessed by 56% of the students. Some missed out on a mark either because they forgot that the amplitude was 5 V, or got the mark–space ratio wrong.

Question 5

05 This question proved to be a good discriminator, with a good spread of marks. However, only a few students (18%) accessed the top mark band. There was considerable evidence of the answer evolving rather than being planned. Consequently, a number wrote a lot but said very little. In particular, only the very good students expanded on the second bullet point by considering the problems created by under- and over-sampling. 57% of students managed to score at least three marks.

Mark Ranges and Award of Grades

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