AQA

# A-level
# MATHEMATICS
## Unit Pure Core 4
## Report on the Examination

6360
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## General

The paper again provided the majority of students with the opportunity to demonstrate their understanding of mathematical procedures and concepts. Many of them were able to develop successful arguments though the more complex later questions again tended to prove to be too demanding for the less able student.

Most students were able to display a good knowledge of a number of basic ideas. Though, in general, the presentation of scripts was good, there were still cases when unnecessary approaches resulted in multiple attempts at solutions and a considerable amount of crossed out work. A number of students still fail to check for simple errors when the answers obtained cast considerable doubt on their validity.

## Question 1

This proved a good start for many students with a fair proportion scoring highly. Perhaps surprisingly, however, a lot of good responses which scored full marks in part (a) were often less successful in part (b).

(a) Many students found the values of the constants A, B and C quickly and efficiently by the anticipated method of equating coefficients of $x^2$ and using the appropriate values of $x = 3$ and $x = -\frac{1}{4}$ in their identity. However a considerable number still tended to get involved in simultaneous equations often leading to unnecessary algebra and wrong values. This type of question is also a prime example where unexpected values for A, B and C should be checked for errors in their working.

(b) This part demonstrated that many students had been taught well in integrals leading to logarithmic solutions with many managing to score the first three marks for the integrations based upon their values of A, B and C. Of those who dropped any marks here, it was usually not being able to cope with the minus sign in $(3 - x)$ or the $4$ in the $(1 + 4x)$ parts of the integrand. Almost all were able to use the limits correctly but many, including some very good students, missed the final mark through not being able to change the correct $\frac{1}{4}\ln 9$ term into $\frac{1}{2}\ln 3$ in order to obtain the required form.

## Question 2

Students who simply used their calculator to find $\alpha$ and $\beta$ before finding $\tan\alpha$ and $\tan\beta$ were unable to score any marks in this question.

(a) Many students appreciated the need for a right angled triangle or the use of an appropriate identity in order to obtain the **exact** values of $\tan\alpha$ and $\tan\beta$ though the vast majority failed to appreciate the significance of $\beta$ being obtuse. Only a handful who appreciated the method needed failed to score any marks in this part.

(b) Almost all students knew the relevant identity for $\tan(\alpha - \beta)$ though a few got the signs the wrong way round whilst others used $\tan\sqrt{2}$ rather than just $\sqrt{2}$ for the value of $\tan\alpha$ etc.

**Question 3**

Students had, in general, a good understanding of this topic.

(a) Almost all students scored at least one mark in this part with any problems usually due to arithmetic errors in finding the term in $x^2$ with only a handful failing to pick up the method mark by not obtaining the first two terms.

(b)(i) As in previous years, practically all students preferred to take out $64^{2/3}$ as a factor before correctly expanding $\left(1-\frac{9}{64}x\right)^{2/3}$ from scratch to score full marks. Few, if any, tried to use the binomial expansion of $(64-9x)^{2/3}$ whilst even fewer saw the opportunity to use (a) with $x$ replaced by $\frac{x}{64}$.

(b)(ii) Although most students found the value of $x=-\frac{1}{3}$ and then used it in their expansion, many were unable to reach the correct form for the answer with the inability to deal with the signs when tidying up the correct intermediate answer of $16+\frac{1}{2}-\frac{1}{256}$ the most common reason although some students thought that $16.5-\frac{1}{256}$ was an acceptable form for the final answer.

**Question 4**

Students are obviously very familiar with the Factor Theorem, with very few thinking that long division was an acceptable method to use.

(a)(i) Almost all of the students used the correct value of $x=-\frac{2}{3}$ and substituted it into $f(x)$ to earn the method mark though a large number did not then earn the accuracy mark by either not showing any appropriate arithmetic or failing to state a relevant conclusion.

(a)(ii) Most of the students managed to obtain all three linear factors with the popular method being to use long division of the cubic by the known linear factor to first find the quadratic factor and then the further two linear factors. Only a handful of those who found the correct quadratic factor subsequently failed to find the other two correct linear factors.

(b)(i) Most students started with $g(\theta)$ and a good proportion of these used the correct identities to obtain a cubic in $\sin\theta$ but often the last mark was not gained, as simplifying it to the required form was often carried out before it had been equated to 0. Only a handful tried to work backwards from the cubic in $\sin\theta$ to the given form of $g(\theta)$ and this approach usually proved unsuccessful as the form of the identity needed was less obvious.

(b)(ii) There were many correct solutions to this part using the links between part (b) and (a) and usually gave the two answers to the required accuracy. Having said that there were still a number who couldn't find the answers in the relevant quadrants or gave more answers than were valid.

**Question 5**

This question covered the full spectrum of grades with most, if not all, being able to cope with parts of it but only a handful being successful with the whole question.

(a) Most students managed full marks though a handful used $t = 1$ rather than $t = 0$ in (i) whilst some failed to correctly give their answer to (ii) to the desired accuracy. In (iii) the majority used logarithms (though not essential in this part) and gained full reward despite inequalities sometimes appearing confused. A handful clearly misread the question and used species P rather than Q in this part but did sufficient equivalent work to earn the method mark.

(b) A large percentage of students wrongly used P = 4Q and, although they then adopted an otherwise correct approach did not realise that the negative answer meant that their work needed to be checked. Because of the fundamental error involved this approach could not gain any credit. Of those who set up the models correctly, the majority then used logarithms (as stipulated in the question) to reach the correct solution though some struggled with combining the powers or simplifying their initial logarithmic form.

(c) Only the better students completed this part with many setting up the models the wrong way round. Of those who did manage to obtain the required quadratic and solve it correctly, many failed to appreciate that their answer for T was in weeks and needed to be multiplied by 7 to score the final mark.

**Question 6**

Again the question involving implicit differentiation provided most students with some marks despite many not being able to find the correct value of k in part (a). This did not penalise further marks as any constant differentiates to zero anyway.

In (b) many could cope with the implicit differentiation of $\cos 3y$ but the major problem was in applying the product rule to the differentiation of $y \sin^2 3x$ with a fair proportion not appreciating that the chain rule was also needed. The most common wrong answer when attempting to use the product rule involved variations of the form $\frac{\mathrm{dy}}{\mathrm{dx}} \times \sin^2 3x + y \times \cos^2 3x$. A fair proportion also felt it necessary to replace $\sin^2 3x$ in terms of $\cos 6x$ before differentiating whilst only a handful thought that this term could be differentiated without using the product rule at all. There were very few cases of a spurious $\frac{\mathrm{dy}}{\mathrm{dx}} = \cdots$ appearing on the LHS of the equation. Almost all students, independent of how many of the first 4 marks they achieved, gave the answer in the required form.

In (c) almost all knew that they had to obtain the gradient using $x = \frac{\pi}{2}$ and $y = \frac{3\pi}{2}$ in their expression for $\frac{\mathrm{dy}}{\mathrm{dx}}$ but many failed to achieve the accuracy mark although the ‘correct’ answer could be obtained from a number of wrong derivatives - needless to say that these situations weren’t rewarded. Disappointingly, a few otherwise faultless solutions were spoiled by the final answer not being given in the requested form of $y = mx + c$.

**Question 7**

(a) Despite the substitution not being given the vast majority of students chose the most suitable one of $u = 7 + 2x^2$ and, many of them obtained the correct answer in terms of $x$. However a number of solutions were spoiled by either the final answer being left in terms of $u$, thinking that $\int \frac{1}{u^2}\, du$ was $\ln u^2$ or the factor 4 being moved into the numerator when $\frac{1}{4u^2}$ became $4u^{-2}$ before integrating. The substitution of $u = 2x^2$ also often proved quite successful but many other attempted substitutions including just $u = x$ invariably proved fruitless. Attempts that used the 'or otherwise' suggestion were invariably based on integration by parts. A few were able to spot the answer by inspection.

(b) The separation of variables was often done correctly though the omission of the integral signs or one or both of the 'dy' or 'dx' expressions being missing caused some students to be unable to gain this mark. A few students also wrongly incorporated $x$ with the $e^{4y}$ before trying to integrate. Those who separated correctly could often cope with both integrations, appreciating that the function in $x$ was linked with their answer to part (a). Practically all students included a constant of integration and used the boundary conditions in an attempt to find its value. Although errors may have occurred practically all of the students expressed their final answer in the required form though some very good solutions were spoiled by taking logarithms incorrectly with what should have been $\ln\left(\frac{3}{7+2x^2} + \frac{4}{5}\right)$ being given as $\ln\left(\frac{3}{7+2x^2}\right) + \ln\left(\frac{4}{5}\right)$.

**Question 8**

In (a) a number of students were unable to find the correct co-ordinates of point B from the given parameter value - this, of course, has considerable effect on the rest of this part. Most students adopted the scalar product approach and there were many correct answers although a handful of students appeared unable to give the required acute angle from the obtuse angle of $161.4°$. Others who knew which vectors needed to be used could not gain full marks due to their co-ordinates for B being incorrect. There were again many students who didn't appreciate which vectors were needed and the use of just the co-ordinates of the given points A and C was frequent. A handful of students opted to find the angle using the cosine rule, a method which usually proved successful.

In (b) there were a number of correct solutions though some solutions were spoiled by an arithmetic slip which resulted in wrong co-ordinates for D, and hence E. In the main, however, the unstructured format proved too demanding for most students and, although many started by finding the vector equation of the line AC and hence the parametric form for the co-ordinates of D, they then tended to struggle with any further assimilation. There were also many cases where, following the correct co-ordinates of D being found, the next step of finding E proved too difficult.

## 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