

# Examiners' Report Summer 2009

AEA

## AEA Mathematics (9801)

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# Advanced Extension Award Unit AEA Specification 9801

## Introduction

The overall quality of the work this year was not quite as good as last summer but there were some excellent scripts seen. Questions 2 and especially the second half of 7 were the least well answered whilst questions 1, 4 and 6 were tackled well by most candidates. Some candidates could not quote basic formulae such as the cosine rule in question 5 (it is given in the formula booklet!) or recall standard mathematical facts such as  $\sin\left(\frac{\pi}{3}\right) = \frac{\sqrt{3}}{2}$  in question 3 and this hampered their performance.

## Report on individual questions

### Question 1

The graphs were usually both correct although some had a “smooth curve” at the origin rather than a “sharp point” for the mod graph. Almost everyone identified the intersection at  $x = 2$ , although this was often after solving a quadratic equation. The second intersection caused more problems as some candidates were uncertain which of the  $x$  terms changed sign and those who did solve the correct equation sometimes failed to choose between  $\frac{-1 \pm \sqrt{17}}{4}$ .

### Question 2

The challenge here was how to represent  $y = x^{\sin x}$  in a form for which standard differentiation rules could be applied. Those who connected powers of  $x$  with logarithms or the exponential function were able to write  $\ln y = \sin x \ln x$  or  $y = e^{\sin x \ln x}$  and usually completed part (a) successfully. Some candidates had learnt the derivative of  $a^x$ , where  $a$  is a constant, and tried applying that whilst others just wrote down  $\sin x \cdot x^{\sin x - 1}$  or  $\sin x \cdot \cos x \cdot x^{\sin x - 1}$ .

In part (b) those with a tangent of  $y = x$  were usually able to show that there were infinitely many points of intersection given by  $\sin x = 1$  but the general solution of this equation was sometimes given as  $x = \frac{\pi}{2} + k\pi$  rather than  $x = \frac{\pi}{2} + 2k\pi$ . Only a handful of candidates addressed the “touching” aspect of the question though and showed that the derivative of the function was also 1 at each of these points.

### Question 3

There were many fully correct solutions to part (a) although some candidates did not choose a very efficient route. Part (b) was more challenging and the weaker candidates simply thought that taking a sine of both sides would give them the equation  $1 - 2x = \frac{\pi}{3} - x$ , others tried to use

part (a) and thought  $x$  or  $\theta = \frac{\pi}{6}$ . Many expanded a sum or difference of sine or cosine but the

stumbling block was writing  $\cos(\arcsin x) = \sqrt{1 - x^2}$ , or equivalent, and some promising solutions stopped at this point. Those who were able to square and obtain a quadratic in  $x$  usually managed to complete the question successfully.

### Question 4

Most candidates handled the generalised nature of part (a) successfully but some did not use  $x = k$  at the end thus failing to appreciate that the result is only valid at the stationary point. Only a handful of candidates saw how this result could simplify their working in (b)(iv). In part (b) most gave the correct coordinates of  $A$  and the equations of the vertical asymptotes but the horizontal asymptote was often incorrect with  $y = 1$  appearing quite frequently. The expression for the area of the triangle was usually derived satisfactorily and the candidates usually went on to use differentiation to find a stationary point. Some differentiated the equation of  $C$  but many successfully found  $a = \sqrt{3}$  and usually went on to find the corresponding area although they often failed to establish that this was the minimum area.

### Question 5

In part (a)(i) many students struggled to establish that angle  $B = 60^\circ$ , the simple use of the sum of the first 3 terms of the arithmetic series being equal to 180 eluded them. Some invented values for all three angles and 30, 60, 90 was quite common but we allowed them to use  $B = 60^\circ$ , along with the area formula, to reach the printed result. A simple application of the sine rule or  $\frac{1}{2}bc \sin A$  led most candidates to  $b = \sqrt{5}$ . Some lengthy solutions were seen to part (a) (iii) sometimes involving complicated surd work to find  $\sin C$  or  $\cos C$  but a good number of the candidates did obtain a correct expression for  $c$ . Those who assumed angle  $C = 90^\circ$  gained no credit.

Part (b) turned out to be quite testing. A common approach was to use the  $n$ th term of the arithmetic series and then impose the condition that this value must be less than 180. This gives a whole range of values for  $n$  but only one of these is valid. The key was to consider the sum of the internal or external angles and candidates who used this approach were usually able to show that  $n = 18$  or 20 and **then** use the less than 180 degrees condition to show that  $n = 18$ .

## Question 6

Part (a) was answered well although some tried to disguise their incorrect value for the gradient at  $P$  as they worked towards the printed answer. Many stated their strategy for answering part (b) at the start and often managed to find the area of the triangle correctly. The area under the curve required some careful and persistent application of standard integration techniques and there were a good number of fully correct solutions. Most used the parametric form but a Cartesian approach proved equally successful the key to both approaches being to use integration by parts the correct way around. A few candidates used the area of a trapezium and  $\int x \, dy$  which yielded the result quite efficiently.

## Question 7

The first two parts were usually answered quite well but only the very best candidates made much progress with parts (c) and (d). In part (a) those who used the scalar product often had a sign error or failed to realise that they needed both vectors pointing to or away from the angle. Some used the cosine rule as an alternative. Most realised in part (b) that the area of the kite was twice the area of triangle  $ABC$  and were able to arrive at the value of 30 and at this point most solutions ground to a halt. There were some diagrams drawn but some drew  $ABDC$  and others had diagrams looking like a rhombus which often led to the false assumption that the centre of the circle was at the midpoint of  $AC$ . Some realised that the radii would be perpendicular to  $AB$  and  $BC$  and just occasionally they used an area approach to form an equation for  $r$  as in the mark scheme for part (c). In part (d) many found the vector  $AC$  and they usually realised that  $BD$  was perpendicular to  $AC$  but few had a viable strategy for finding  $OD$ .





## Grade Boundaries

	Distinction	Merit
9801 AEA Mathematics	69	51





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