Write your name here

Surname	Other names

Edexcel IGCSE

Centre Number	Candidate Number

Further Pure Mathematics

Paper 2

Tuesday 21 June 2011 – Morning
Time: 2 hours

Paper Reference
4PM0/02

Calculators may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

Turn over ▶

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P 3 8 6 4 8 R A 0 1 3 2

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Answer all ELEVEN questions
Write your answers in the spaces provided
You must write down all stages in your working

1 Evaluate $\sum_{n=6}^{20}(2n-3)$

(3)

(Total for Question 1 is 3 marks)

2 A particle is moving along a straight line. At time t seconds, $t \geqslant 0$, the displacement, s metres, of the particle from a fixed point of the line is given by $s = t^3 + 2t^2 - 3t + 6$

Find the value of t for which the particle is moving with velocity 12 m/s.

(4)

(Total for Question 2 is 4 marks)

3 In triangle ABC, $AB = 5$ cm, $AC = 3$ cm, angle $B = 25°$ and angle C is obtuse.

(a) Find, to the nearest degree, the size of angle C.

(3)

The point D lies on BC produced and $AD = 3$ cm.

(b) Find, to 3 significant figures, the length of CD.

(3)

Question 3 continued

(Total for Question 3 is 6 marks)

4 A curve has equation $y = x^3 + 2x^2 - 11x - m$, where m is a positive integer. The curve crosses the x-axis at the point with coordinates $(-4, 0)$.

(a) Show that $m = 12$

(2)

(b) Factorise $x^3 + 2x^2 - 11x - 12$ completely.

(3)

The curve also crosses the x-axis at two other points.

(c) Write down the x-coordinate of each of these points.

(1)

Question 4 continued

(Total for Question 4 is 6 marks)

5 Relative to a fixed origin O, the position vector of the point A is $5\mathbf{i} + p\mathbf{j}$ and the position vector of the point B is $q\mathbf{i} + 12\mathbf{j}$. The point D with position vector $13\mathbf{i} + 10\mathbf{j}$ divides the line AB in the ratio $2:1$

(a) Find the value of p and the value of q.

(3)

The points A, B and E lie in that order on a straight line and $AE : BE$ is $5:2$

(b) Find, in terms of $\mathbf{i}$ and $\mathbf{j}$, the position vector of the point E.

(3)

Question 5 continued

(Total for Question 5 is 6 marks)

6

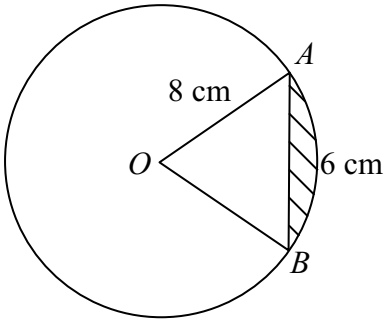

Figure 1

Figure 1 shows a circle, centre O, with radius 8 cm. The arc AB has length 6 cm.

(a) Find, in radians, the size of angle AOB.

(2)

(b) Find the area of the sector AOB.

(2)

(c) Find, to 3 significant figures, the area of the shaded segment.

(3)

Question 6 continued

(Total for Question 6 is 7 marks)

7

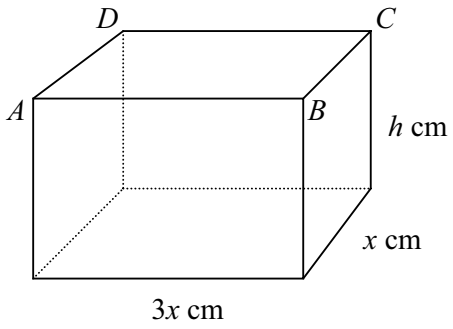

Figure 2

A rectangular box has length $3x$ cm, width x cm and height h cm, as shown in Figure 2. The top of the box, $ABCD$, is open. The volume of the box is 30 cm^3 and the total external surface area of the box is S cm^2.

(a) Show that $S = 3x^2 + \frac{80}{x}$

(4)

Given that x can vary,

(b) find, to 3 significant figures, the minimum value of S.

(5)

(c) Verify that your answer to part (b) does give the minimum value for S.

(2)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 11 marks)

8 The sum of the first and third terms of a geometric series is 100

The sum of the second and third terms is 60

(a) Find the two possible values of the common ratio of the series.

(5)

Given that the series is convergent, find

(b) the first term of the series,

(2)

(c) the least number of terms for which the sum is greater than 159.9

(4)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

9 (a) Expand $\left(1-\frac{3x}{4}\right)^{\frac{1}{3}}$ in ascending powers of x up to and including the term in x^3, simplifying your terms as far as possible.

(3)

(b) Expand $\left(1+\frac{3x}{4}\right)^{-\frac{1}{3}}$ in ascending powers of x up to and including the term in x^3, simplifying your terms as far as possible.

(3)

(c) Write down the range of values of x for which both of your expansions are valid.

(1)

(d) Expand $\left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}}$ in ascending powers of x up to and including the term in x^3, simplifying your terms as far as possible.

(3)

(e) Hence obtain an estimate, to 3 significant figures, of

$$\int_0^{0.5}\left(\frac{4-3x}{4+3x}\right)^{\frac{1}{3}}\mathrm{d}x$$

(4)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 14 marks)

10 The roots of the equation $x^2 + 6x + 2 = 0$ are α and β, where $\alpha > \beta$. Without solving the equation

(a) find

(i) the value of $\alpha^2 + \beta^2$

(ii) the value of $\alpha^4 + \beta^4$

(5)

(b) Show that $\alpha - \beta = 2\sqrt{7}$

(3)

(c) Factorise completely $\alpha^4 - \beta^4$

(2)

(d) Hence find the exact value of $\alpha^4 - \beta^4$

(2)

Given that $\beta^4 = A + B\sqrt{7}$ where A and B are positive constants

(e) find the value of A and the value of B.

(2)

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 14 marks)

11 $\mathrm{f}(x) = x^2 + 6x + 8$

Given that $\mathrm{f}(x)$ can be expressed in the form $(x + A)^2 + B$ where A and B are constants,

(a) find the value of A and the value of B.

(3)

(b) Hence, or otherwise, find

(i) the value of x for which $\mathrm{f}(x)$ has its least value

(ii) the least value of $\mathrm{f}(x)$.

(2)

The curve C has equation $y = x^2 + 6x + 8$

The line l, with equation $y = 2 - x$, intersects C at two points.

(c) Find the x-coordinate of each of these two points.

(4)

(d) Find the x-coordinate of the points where C crosses the x-axis.

(2)

(Parts (e) and (f) follow on page 30 and 31)

Question 11 continued

Turn over for parts (e) and (f)

Question 11 continued

The curve C has equation $y = x^2 + 6x + 8$ and the line l has equation $y = 2 - x$

In the space below,

(e) sketch, on the same axes, the curve C and the line l.

(2)

(f) Find the area of the finite region bounded by the curve C and the line l.

(5)

Question 11 continued

Question 11 continued

(Total for Question 11 is 18 marks)

TOTAL FOR PAPER IS 100 MARKS