Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments	Total Marks

PAPER 1

ADVANCED SUBSIDIARY

CM

Practice Paper B

Time allowed: 2 hours

Instructions to candidates:

- In the boxes above, write your centre number, candidate number, your surname, other names and signature.
- Answer ALL of the questions.
- You must write your answer for each question in the spaces provided.
- You may use a calculator.

Information to candidates:

- Full marks may only be obtained for answers to ALL of the questions.
- The marks for individual questions and parts of the questions are shown in round brackets.
- There are 12 questions in this question paper. The total mark for this paper is 100.

Advice to candidates:

- You should ensure your answers to parts of the question are clearly labelled.
- You should show sufficient working to make your workings clear to the Examiner.
- Answers without working may not gain full credit.

AS/B1

1 0 3 3 2 2 1 2 8 0 0 0 4

1 **Figure 1** shows a sketch of the curve C with equation $y = \dfrac{1}{x+k}$, where k is a constant.

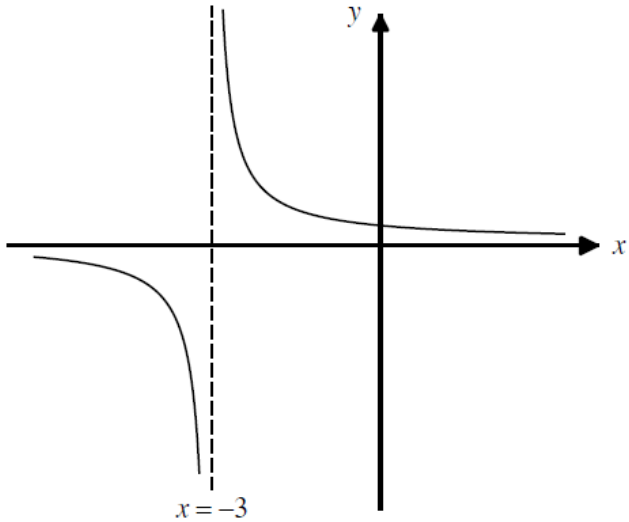


Figure 1

(a) Write down the value of k. **(1)**

The sketch of the curve C in **Figure 1** is given on page 3.

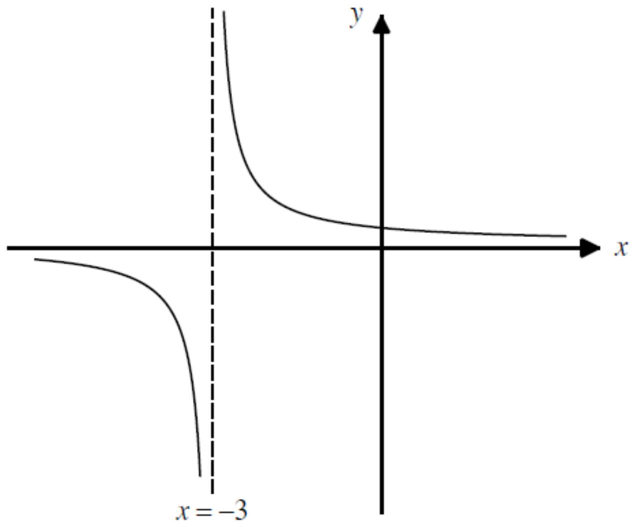
(b) On these axes, sketch the curve with equation $y = x^3 - 4x^2 + 4x$.

On your sketch, you should show clearly the coordinates of any points where the curve crosses or meets the coordinate axes. **(3)**

(c) State, with a reason, the number of solutions to the equation

$$x^3 - \frac{1}{x+k} = 4x^2 - 4x$$

(2)



2 Evaluate

$$\int_1^4 \left(\sqrt{x} - 2x^{-3} + 4\right) dx$$

giving your answer as an exact value in its simplest form. **(5)**

3 Three forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ act on a particle P. Given that

$\mathbf{F}_1 = (4\mathbf{i} + 6\mathbf{j})$ newtons

$\mathbf{F}_2 = (-2\mathbf{i} + \mathbf{j})$ newtons

$\mathbf{F}_3 = (-5\mathbf{i} - 7\mathbf{j})$ newtons

(a) find the magnitude of the resultant force $\mathbf{F}_R = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3$ acting on P. **(3)**

A fourth force $\mathbf{F}_4$ newtons now also acts on P. The new resultant force on P is $\mathbf{F}_{R*}$, where $\mathbf{F}_{R*} = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4$. Given that $\mathbf{F}_{R*}$ acts at a bearing of 045°,

(b) find, in terms of $\mathbf{i}$ and $\mathbf{j}$, possible components of the force $\mathbf{F}_4$. **(3)**

4 (a) Show in clear stages that

$$\frac{a+\sqrt{b}}{c+\sqrt{d}} = \frac{ac}{c^2-d} + \frac{-a\sqrt{d} + c\sqrt{b} - \sqrt{bd}}{c^2-d}$$

where a, b, c and d are positive constants. **(5)**

Given that m is rational,

(b) find the value of m such that $\dfrac{m+\sqrt{2}}{1+\sqrt{8}}$ is rational. **(2)**

5 (a) Differentiate $6x^2 + 1$ from first principles with respect to x. **(4)**

The curve C has the equation $y = \mathrm{f}(x)$. Given that

$$\mathrm{f}(x) = x^3 - 2x^2 + 11x - 4$$

(b) show that the there is no normal line to C with gradient $-\dfrac{1}{2}$. **(7)**

6 The number of plants infected with a disease in a field varies according to the formula

$$N = 90\left(2 - e^{-0.05t}\right)$$

where N is the number of plants infected with the disease and t is the time, in days, since the outbreak. There are 150 plants in the field at risk of being infected with the disease.

(a) Find the number of plants infected with the disease at the time of outbreak. **(2)**

(b) Calculate $\frac{dN}{dt}$. **(2)**

(c) Use your answer to part (b) to explain why the number of plants infected with the disease is increasing with time. **(1)**

(d) (i) Explain why the model will eventually become unrealistic. **(1)**

(ii) Calculate the value of t at which the model becomes unrealistic. **(3)**

7 The straight line l passes through the points $(4,5)$ and $(12,-3)$.

(a) Find the equation of the straight line l giving your answer in the form $ax + by + c = 0$, where a, b and c are constants to be found. **(4)**

The curve C has the equation $y = 3x^2 + 4x + 7$.

The curve C and the straight line l intersect at the points A and B.

Figure 2 below shows the curve C, the straight line l_1 and the points A and B.

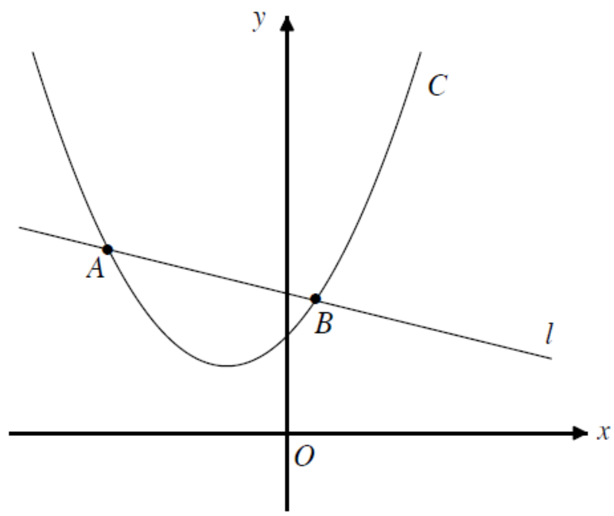


Figure 2

(b) Find the coordinates of the points A and B. **(5)**

The line l crosses the y axis at the point P.

(c) Show that the ratio $|AP|:|BP|$ is m : 1, where m is an integer to be found. **(3)**

8 The coefficient of the term in x^6 in the expansion of $(1 - px)^{15}$ is 3648645.

(a) Find the value of the constant p. **(3)**

(b) Find the coefficient of the term in x^8, giving your answer to four significant figures. **(2)**

9 The triangle ABC has $AB = a$ cm, $BC = b$ cm and $AC = 14$ cm, as shown in **Figure 3**. The perimeter of the triangle ABC is 40 cm.

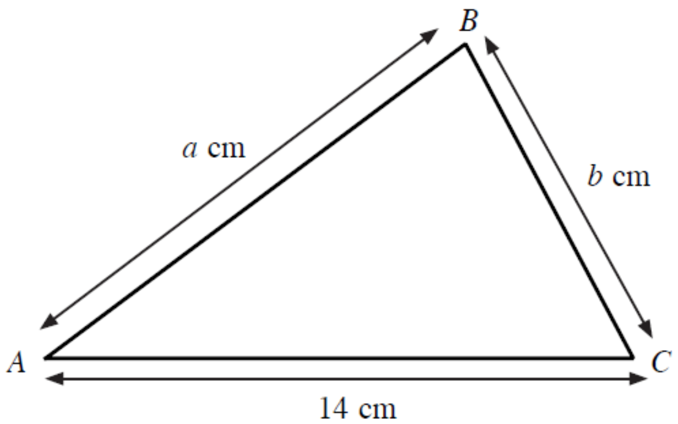


Figure 3

Given that the angle $ACB = \theta$,

(a) show that $\cos\theta = \dfrac{13}{7} - \dfrac{120}{7b}$. **(4)**

(b) Show that the area of the triangle A cm² satisifies $A^2 = -120b^2 + 3120b - 14400$. **(4)**

(c) (i) Find the maximum area of the triangle ABC. **(4)**

(ii) State the type of triangle ABC is when its area is a maximum. **(1)**

10 (a) Use a counterexample to show that if n is an integer, n^2+1 is not necessarily prime. **(2)**

(b) By manipulating the indices, prove that $(-1)^{x+y} = (-1)^{x-y}$ for integers x and y. **(3)**

(c) Explain how part (b) can be used to prove that $x+y$ is even if and only if $x-y$ is even. **(1)**

11 (a) Prove that

$$\frac{1}{\sin x} - \sin x \equiv \frac{\cos x}{\tan x}$$

(2)

(b) Hence, or otherwise, solve the equation

$$4 + \sin^2 X\left(\cos^2 X\right)^{-1} = \frac{2}{\cos X}\left(\sin X - \frac{1}{\sin X}\right) + \tan^2 X$$

for $-360° \leq X \leq 360°$. **(6)**

12 (a) Show that the $x = 1$ is the only real root of the equation $4x^3 + 6x - 10 = 0$. **(5)**

The variable point $P(x, y)$ lies on the curve C with equation $y = x^2$. The point Q has the coordinates $(5, -1)$.

(b) Show that the distance d between the points P and Q satisfies the equation

$$d^2 = x^4 + 3x^2 - 10x + 26$$

(3)

(c) Hence, or otherwise, use calculus to find the coordinates of the point on C that is closest to the point Q. Justify that your point on C is the closest point to Q by further calculus. **(5)**