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#1 HOME TUITION AGENCY

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# SINGAPORE'S #1 HOME TUITION AGENCY

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**Mathematics  
 Standard level  
 Paper 1**

Wednesday 11 November 2015 (morning)

Candidate session number

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1 hour 30 minutes

**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions in the boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.



Please **do not** write on this page.  
 Answers written on this page will not be marked.



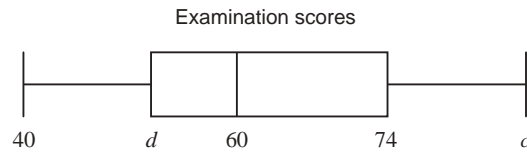
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

**Section A**

Answer **all** questions in the boxes provided. Working may be continued below the lines if necessary.

1. [Maximum mark: 5]

The following box-and-whisker plot represents the examination scores of a group of students.



(a) Write down the median score.

[1]

The range of the scores is 47 marks, and the interquartile range is 22 marks.

(b) Find the value of

(i)  $c$ ;

(ii)  $d$ .

[4]

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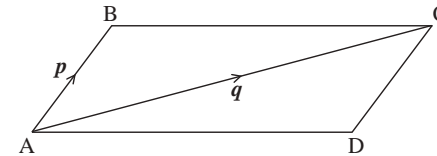
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2. [Maximum mark: 7]

The following diagram shows the parallelogram ABCD.



Let  $\vec{AB} = p$  and  $\vec{AC} = q$ . Find each of the following vectors in terms of  $p$  and/or  $q$ .

(a)  $\vec{CB}$

[2]

(b)  $\vec{CD}$

[2]

(c)  $\vec{DB}$

[3]

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16EP03



16EP04

3. [Maximum mark: 6]

Let  $f'(x) = 6x^2 - 5$ . Given that  $f(2) = -3$ , find  $f(x)$ .

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4. [Maximum mark: 7]

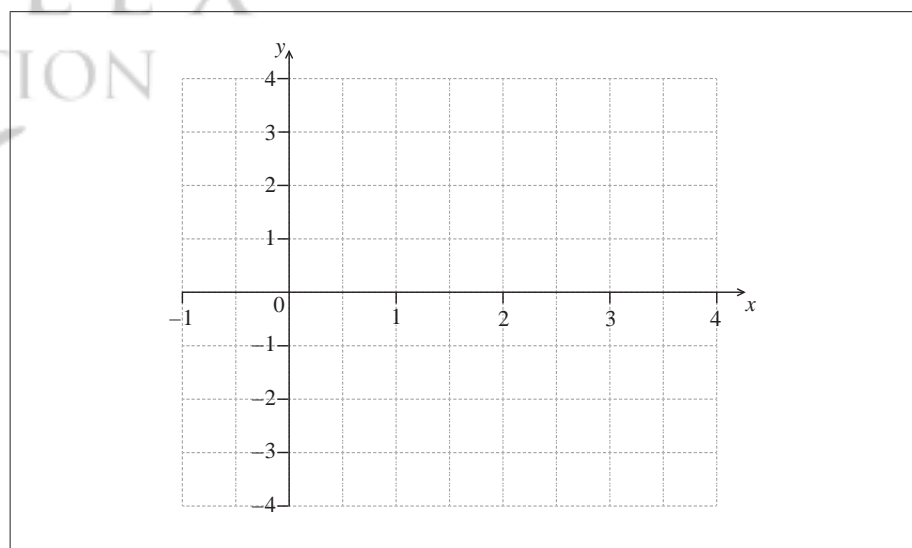
Let  $f(x) = 3 \sin(\pi x)$ .

(a) Write down the amplitude of  $f$ . [1]

(b) Find the period of  $f$ . [2]

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(c) On the following grid, sketch the graph of  $y = f(x)$ , for  $0 \leq x \leq 3$ . [4]



5. [Maximum mark: 6]

6. [Maximum mark: 7]

Let  $f(x) = (x - 5)^3$ , for  $x \in \mathbb{R}$ .

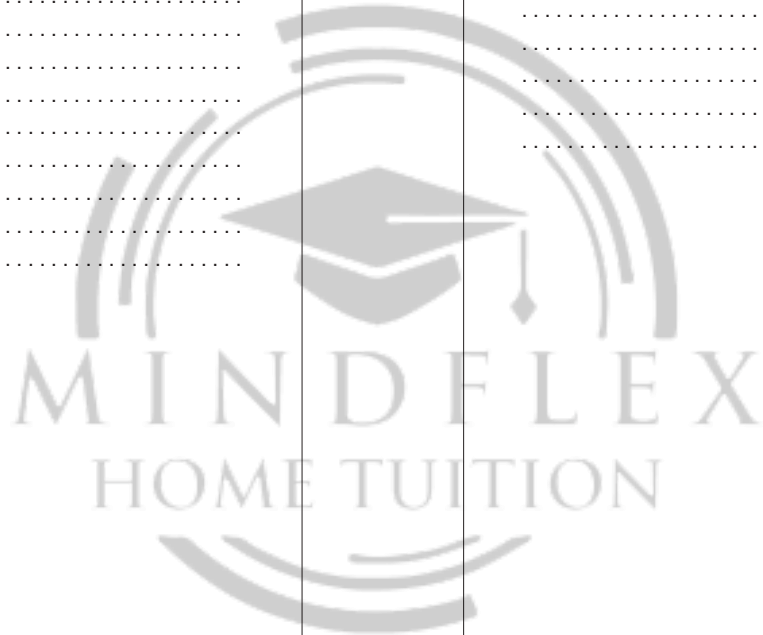
In the expansion of  $(3x + 1)^n$ , the coefficient of the term in  $x^2$  is  $135n$ , where  $n \in \mathbb{Z}^+$ . Find  $n$ .

(a) Find  $f^{-1}(x)$ . [3]

(b) Let  $g$  be a function so that  $(f \circ g)(x) = 8x^6$ . Find  $g(x)$ . [3]

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16EP07



16EP08

7. [Maximum mark: 6]

An arithmetic sequence has the first term  $\ln a$  and a common difference  $\ln 3$ .  
The 13th term in the sequence is  $8\ln 9$ . Find the value of  $a$ .

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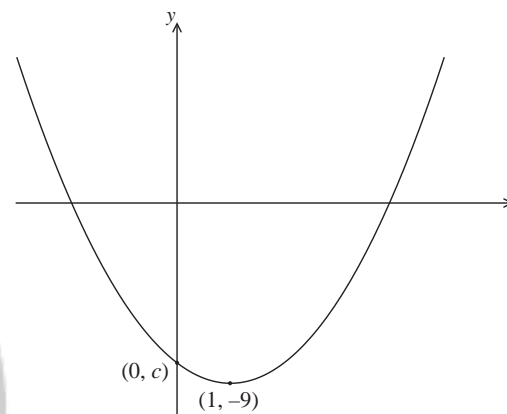
Do **not** write solutions on this page.

**Section B**

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

8. [Maximum mark: 16]

The following diagram shows part of the graph of a quadratic function  $f$ .



The vertex is at  $(1, -9)$ , and the graph crosses the  $y$ -axis at the point  $(0, c)$ .

The function can be written in the form  $f(x) = (x - h)^2 + k$ .

(a) Write down the value of  $h$  and of  $k$ . [2]

(b) Find the value of  $c$ . [2]

Let  $g(x) = -(x - 3)^2 + 1$ . The graph of  $g$  is obtained by a reflection of the graph of  $f$  in the  $x$ -axis, followed by a translation of  $\begin{pmatrix} p \\ q \end{pmatrix}$ .

(c) Find the value of  $p$  and of  $q$ . [5]

(d) Find the  $x$ -coordinates of the points of intersection of the graphs of  $f$  and  $g$ . [7]



16EP09



16EP10

Do **not** write solutions on this page.

9. [Maximum mark: 15]

A line  $L_1$  passes through the points  $A(0, -3, 1)$  and  $B(-2, 5, 3)$ .

(a) (i) Show that  $\vec{AB} = \begin{pmatrix} -2 \\ 8 \\ 2 \end{pmatrix}$ .

(ii) Write down a vector equation for  $L_1$ .

[3]

A line  $L_2$  has equation  $\mathbf{r} = \begin{pmatrix} -1 \\ 7 \\ -4 \end{pmatrix} + s \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$ . The lines  $L_1$  and  $L_2$  intersect at a point  $C$ .

(b) Show that the coordinates of  $C$  are  $(-1, 1, 2)$ .

[5]

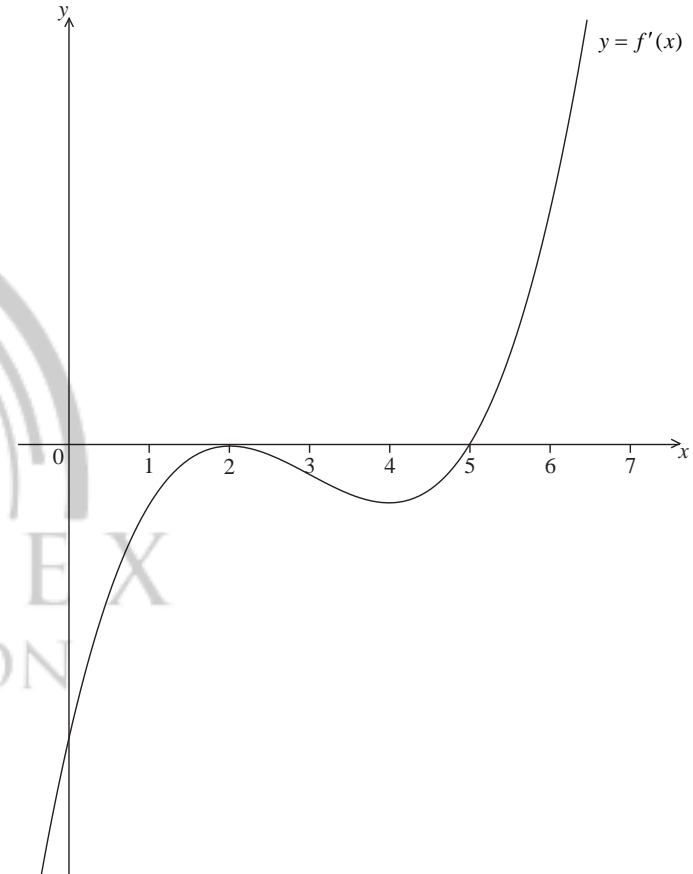
(c) A point  $D$  lies on line  $L_2$  so that  $|\vec{CD}| = \sqrt{18}$  and  $\vec{CA} \cdot \vec{CD} = -9$ . Find  $\hat{ACD}$ .

[7]

Do **not** write solutions on this page.

10. [Maximum mark: 15]

Let  $y = f(x)$ , for  $-0.5 \leq x \leq 6.5$ . The following diagram shows the graph of  $f'$ , the derivative of  $f$ .



The graph of  $f'$  has a local maximum when  $x = 2$ , a local minimum when  $x = 4$ , and it crosses the  $x$ -axis at the point  $(5, 0)$ .

(a) Explain why the graph of  $f$  has a local minimum when  $x = 5$ .

[2]

(b) Find the set of values of  $x$  for which the graph of  $f$  is concave down.

[2]

(This question continues on the following page)



16EP11



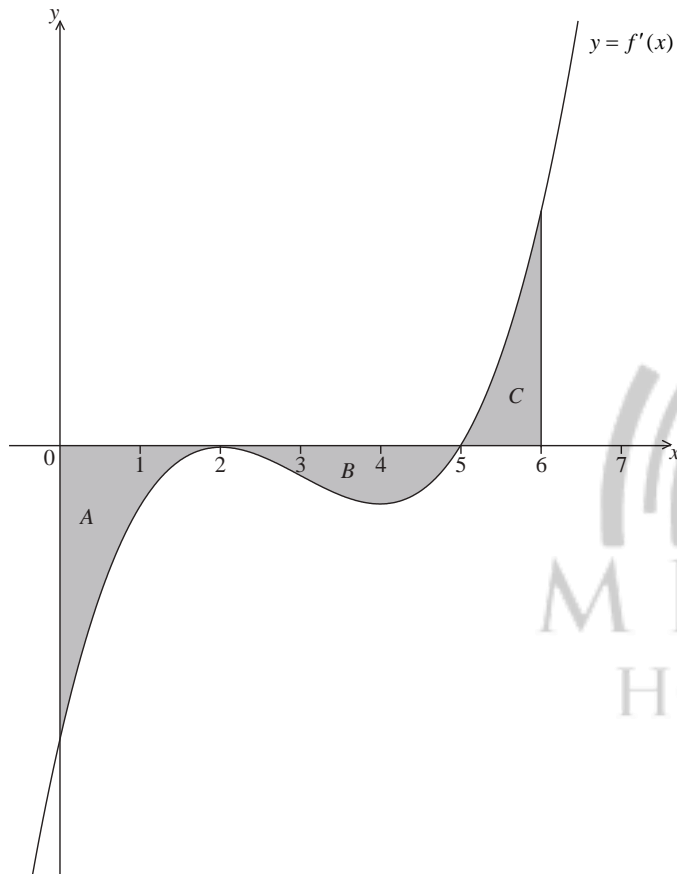
16EP12



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**(Question 10 continued)**

The following diagram shows the shaded regions  $A$ ,  $B$  and  $C$ .



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Answers written on this page will not  
be marked.

The regions are enclosed by the graph of  $f'$ , the  $x$ -axis, the  $y$ -axis, and the line  $x = 6$ .  
The area of region  $A$  is 12, the area of region  $B$  is 6.75 and the area of region  $C$  is 6.75.

- (c) Given that  $f(0) = 14$ , find  $f(6)$ . [5]
- (d) Let  $g(x) = (f(x))^2$ . Given that  $f'(6) = 16$ , find the equation of the tangent to the graph of  $g$  at the point where  $x = 6$ . [6]



16EP13



16EP14

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be marked.

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**Mathematics  
Standard level  
Paper 2**

Thursday 12 November 2015 (afternoon)

1 hour 30 minutes

Candidate session number

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**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions in the boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.

Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. In particular, solutions found from a graphic display calculator should be supported by suitable working, for example, if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

**Section A**

Answer **all** questions in the boxes provided. Working may be continued below the lines if necessary.

1. [Maximum mark: 6]

The following diagram shows a circle with centre O and radius 3 cm.

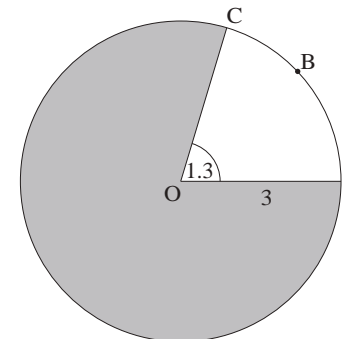


diagram not to scale

Points A, B, and C lie on the circle, and  $\hat{AOC} = 1.3$  radians.

(a) Find the length of arc ABC. [2]

(b) Find the area of the shaded region. [4]

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2. [Maximum mark: 5]

The following table shows the probability distribution of a discrete random variable  $X$ .

$x$	0	1	2	3
$P(X = x)$	0.15	$k$	0.1	$2k$

(a) Find the value of  $k$ .

[3]

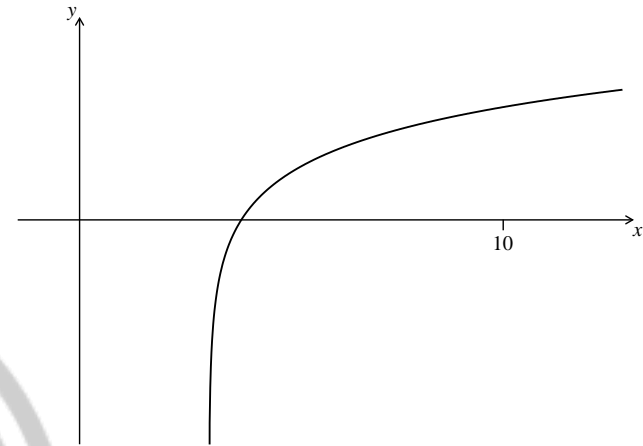
(b) Find  $E(X)$ .

[2]

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3. [Maximum mark: 7]

Let  $f(x) = 2 \ln(x - 3)$ , for  $x > 3$ . The following diagram shows part of the graph of  $f$ .



(a) Find the equation of the vertical asymptote to the graph of  $f$ .

[2]

(b) Find the  $x$ -intercept of the graph of  $f$ .

[2]

(c) The region enclosed by the graph of  $f$ , the  $x$ -axis and the line  $x = 10$  is rotated  $360^\circ$  about the  $x$ -axis. Find the volume of the solid formed.

[3]

(This question continues on the following page)



12EP03



12EP04

(Question 3 continued)

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4. [Maximum mark: 7]

The first three terms of a geometric sequence are  $u_1 = 0.64$ ,  $u_2 = 1.6$ , and  $u_3 = 4$ .

- (a) Find the value of  $r$ . [2]
- (b) Find the value of  $S_6$ . [2]
- (c) Find the least value of  $n$  such that  $S_n > 75000$ . [3]

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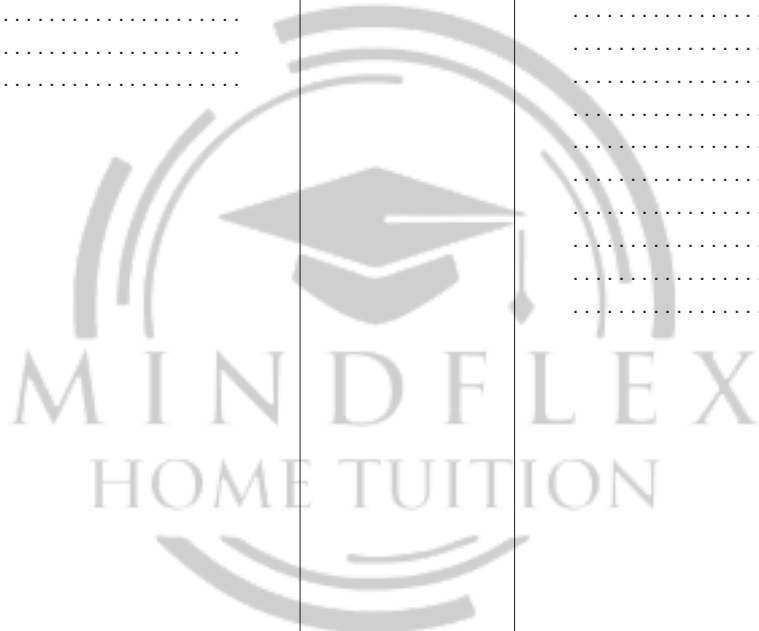
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12EP05

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12EP06

5. [Maximum mark: 7]

Let  $C$  and  $D$  be independent events, with  $P(C) = 2k$  and  $P(D) = 3k^2$ , where  $0 < k < 0.5$ .

- (a) Write down an expression for  $P(C \cap D)$  in terms of  $k$ . [2]
- (b) Given that  $P(C \cap D) = 0.162$ , find  $k$ . [2]
- (c) Find  $P(C' | D)$ . [3]

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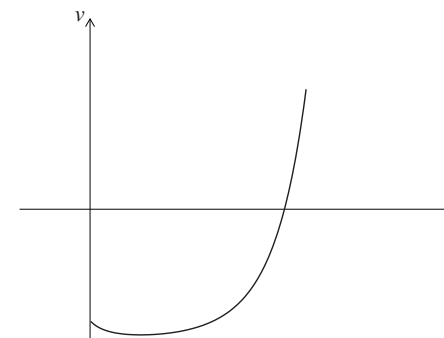
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6. [Maximum mark: 6]

The velocity  $v \text{ m s}^{-1}$  of a particle after  $t$  seconds is given by

$$v(t) = (0.3t + 0.1)^2 - 4, \text{ for } 0 \leq t \leq 5.$$

The following diagram shows the graph of  $v$ .



- (a) Find the value of  $t$  when the particle is at rest. [3]
- (b) Find the value of  $t$  when the acceleration of the particle is 0. [3]

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7. [Maximum mark: 8]

Do **not** write solutions on this page.

Let  $f(x) = \ln(x^2)$ , for  $x \neq 0$ .

- (a) Show that  $f'(x) = \frac{2}{x}$ . [2]
- (b) The tangent to the graph of  $f$  at a point  $P(d, f(d))$  passes through another point  $Q(1, -3)$ . Find the value of  $d$ . [6]

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**Section B**

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

8. [Maximum mark: 14]

The following diagram shows the quadrilateral ABCD.

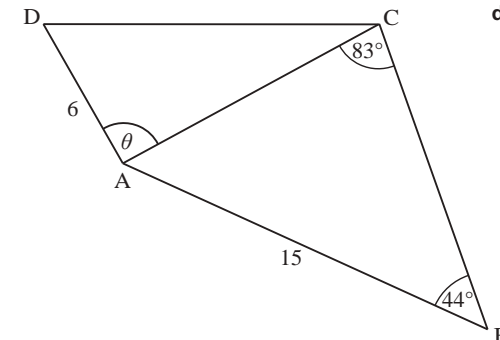


diagram not to scale

$AD = 6 \text{ cm}$ ,  $AB = 15 \text{ cm}$ ,  $\hat{A}BC = 44^\circ$ ,  $\hat{A}CB = 83^\circ$  and  $\hat{D}AC = \theta$

- (a) Find AC. [3]
- (b) Find the area of triangle ABC. [3]
- The area of triangle ACD is half the area of triangle ABC.
- (c) Find the possible values of  $\theta$ . [5]
- (d) Given that  $\theta$  is obtuse, find CD. [3]



12EP09



12EP10

Do **not** write solutions on this page.

9. [Maximum mark: 16]

An environmental group records the numbers of coyotes and foxes in a wildlife reserve after  $t$  years, starting on 1 January 1995.

Let  $c$  be the number of coyotes in the reserve after  $t$  years. The following table shows the number of coyotes after  $t$  years.

number of years ( $t$ )	0	2	10	15	19
number of coyotes ( $c$ )	115	197	265	320	406

The relationship between the variables can be modelled by the regression equation  $c = at + b$ .

- (a) Find the value of  $a$  and of  $b$ . [3]
- (b) Use the regression equation to estimate the number of coyotes in the reserve when  $t = 7$ . [3]
- Let  $f$  be the number of foxes in the reserve after  $t$  years. The number of foxes can be modelled by the equation  $f = \frac{2000}{1 + 99e^{-kt}}$ , where  $k$  is a constant.
- (c) Find the number of foxes in the reserve on 1 January 1995. [3]
- (d) After five years, there were 64 foxes in the reserve. Find  $k$ . [3]
- (e) During which year were the number of coyotes the same as the number of foxes? [4]

Do **not** write solutions on this page.

10. [Maximum mark: 14]

The masses of watermelons grown on a farm are normally distributed with a mean of 10 kg. The watermelons are classified as small, medium or large.

A watermelon is small if its mass is less than 4 kg. Five percent of the watermelons are classified as small.

- (a) Find the standard deviation of the masses of the watermelons. [4]

The following table shows the percentages of small, medium and large watermelons grown on the farm.

small	medium	large
5%	57%	38%

- A watermelon is large if its mass is greater than  $w$  kg.
- (b) Find the value of  $w$ . [2]
- All the medium and large watermelons are delivered to a grocer.
- (c) The grocer selects a watermelon at random from **this** delivery. Find the probability that it is medium. [3]
- (d) The grocer sells all the medium watermelons for \$1.75 each, and all the large watermelons for \$3.00 each. His costs on this delivery are \$300, and his total profit is \$150. Find the number of watermelons in the delivery. [5]



12EP11



12EP12