

Mathematics  
Standard level  
Paper 1

Thursday 4 May 2017 (afternoon)

Candidate session number

1 hour 30 minutes

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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.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions. Answers must be written within the answer 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]**.

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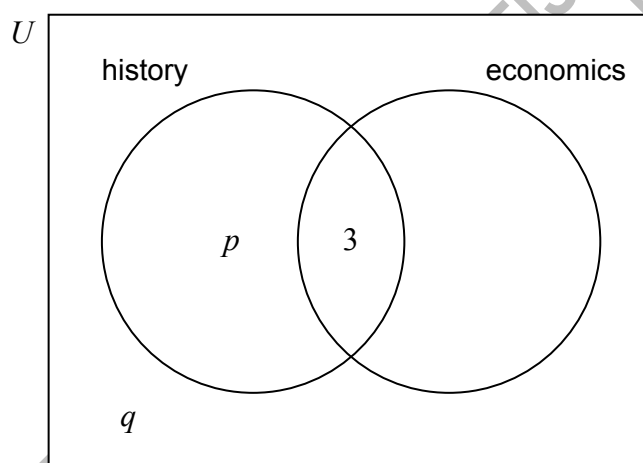
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

### Section A

Answer **all** questions. Answers must be written within the answer boxes provided. Working may be continued below the lines if necessary.

1. [Maximum mark: 6]

In a group of 20 girls, 13 take history and 8 take economics. Three girls take both history and economics, as shown in the following Venn diagram. The values  $p$  and  $q$  represent numbers of girls.



(a) Find the value of

(i)  $p$ ;

(ii)  $q$ .

[4]

(b) A girl is selected at random. Find the probability that she takes economics but not history.

[2]

(This question continues on the following page)



12EP02

(Question 1 continued)

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12EP03

Turn over

2. [Maximum mark: 5]

Let  $f(x) = 5x$  and  $g(x) = x^2 + 1$ , for  $x \in \mathbb{R}$ .

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

[2]

(b) Find  $(f \circ g)(7)$ .

[3]

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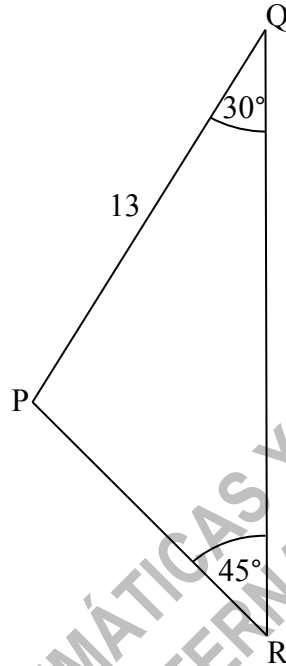


12EP04

3. [Maximum mark: 6]

The following diagram shows triangle PQR.

diagram not to scale



$\hat{PQR} = 30^\circ$ ,  $\hat{QRP} = 45^\circ$  and  $PQ = 13$  cm.

Find PR.

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12EP05

Turn over

4. [Maximum mark: 6]

Jim heated a liquid until it boiled. He measured the temperature of the liquid as it cooled. The following table shows its temperature,  $d$  degrees Celsius,  $t$  minutes after it boiled.

$t$ (min)	0	4	8	12	16	20
$d$ (°C)	105	98.4	85.4	74.8	68.7	62.1

(a) (i) Write down the independent variable.

(ii) Write down the boiling temperature of the liquid.

[2]

Jim believes that the relationship between  $d$  and  $t$  can be modelled by a linear regression equation.

(b) Jim describes the correlation as **very strong**. Circle the value below which best represents the correlation coefficient.

[2]

0.992	0.251	0	-0.251	-0.992
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(c) Jim’s model is  $d = -2.24t + 105$ , for  $0 \leq t \leq 20$ . Use his model to predict the decrease in temperature for any 2 minute interval.

[2]

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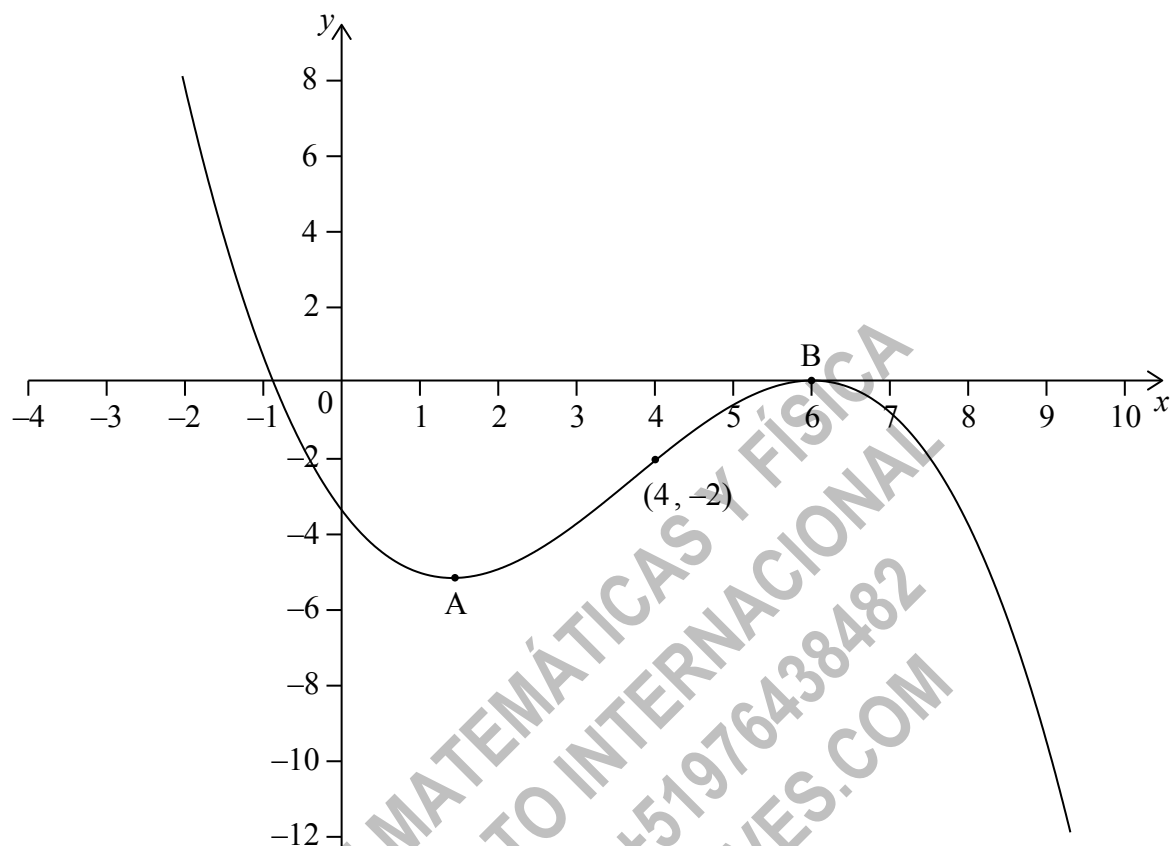


12EP06



6. [Maximum mark: 6]

The following diagram shows the graph of  $f'$ , the derivative of  $f$ .



The graph of  $f'$  has a local minimum at A, a local maximum at B and passes through  $(4, -2)$ .

(a) The point  $P(4, 3)$  lies on the graph of the function,  $f$ .

(i) Write down the gradient of the curve of  $f$  at P.

(ii) Find the equation of the normal to the curve of  $f$  at P. [4]

(b) Determine the concavity of the graph of  $f$  when  $4 < x < 5$  and justify your answer. [2]

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(Question 6 continued)

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12EP09

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7. [Maximum mark: 8]

The first three terms of a geometric sequence are  $\ln x^{16}$ ,  $\ln x^8$ ,  $\ln x^4$ , for  $x > 0$ .

(a) Find the common ratio.

[3]

(b) Solve  $\sum_{k=1}^{\infty} 2^{5-k} \ln x = 64$ .

[5]

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12EP10

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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: 17]

A line  $L_1$  passes through the points  $A(0, 1, 8)$  and  $B(3, 5, 2)$ .

(a) (i) Find  $\vec{AB}$ .

(ii) Hence, write down a vector equation for  $L_1$ . [4]

(b) A second line  $L_2$ , has equation  $\mathbf{r} = \begin{pmatrix} 1 \\ 13 \\ -14 \end{pmatrix} + s \begin{pmatrix} p \\ 0 \\ 1 \end{pmatrix}$ .

Given that  $L_1$  and  $L_2$  are perpendicular, show that  $p = 2$ . [3]

(c) The lines  $L_1$  and  $L_2$  intersect at  $C(9, 13, z)$ . Find  $z$ . [5]

(d) (i) Find a unit vector in the direction of  $L_2$ .

(ii) Hence or otherwise, find one point on  $L_2$  which is  $\sqrt{5}$  units from  $C$ . [5]

9. [Maximum mark: 14]

A quadratic function  $f$  can be written in the form  $f(x) = a(x - p)(x - 3)$ . The graph of  $f$  has axis of symmetry  $x = 2.5$  and  $y$ -intercept at  $(0, -6)$ .

(a) Find the value of  $p$ . [3]

(b) Find the value of  $a$ . [3]

(c) The line  $y = kx - 5$  is a tangent to the curve of  $f$ . Find the values of  $k$ . [8]



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

10. [Maximum mark: 15]

The following table shows the probability distribution of a discrete random variable  $A$ , in terms of an angle  $\theta$ .

$a$	1	2
$P(A = a)$	$\cos \theta$	$2 \cos 2\theta$

- (a) Show that  $\cos \theta = \frac{3}{4}$ . [6]
- (b) Given that  $\tan \theta > 0$ , find  $\tan \theta$ . [3]
- (c) Let  $y = \frac{1}{\cos x}$ , for  $0 < x < \frac{\pi}{2}$ . The graph of  $y$  between  $x = \theta$  and  $x = \frac{\pi}{4}$  is rotated  $360^\circ$  about the  $x$ -axis. Find the volume of the solid formed. [6]

