Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics
Standard level
Paper 1

Thursday 4 May 2017 (afternoon)

Candidate session number

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. 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.
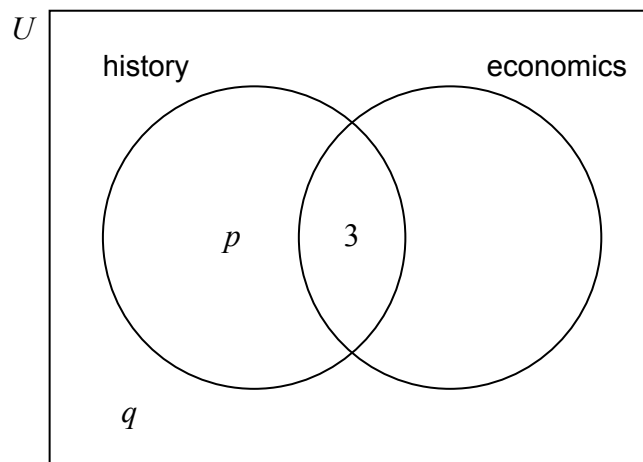
(a)   Find the value of

(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)

(Question 1 continued)

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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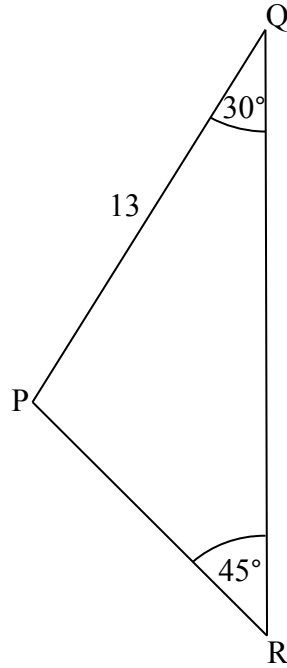..

3.   [Maximum mark: 6]

The following diagram shows triangle PQR.

diagram not to scale

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

Find PR.

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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

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

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5. [Maximum mark: 7]

(a) Find $\int x e^{x^2-1} dx$. [4]

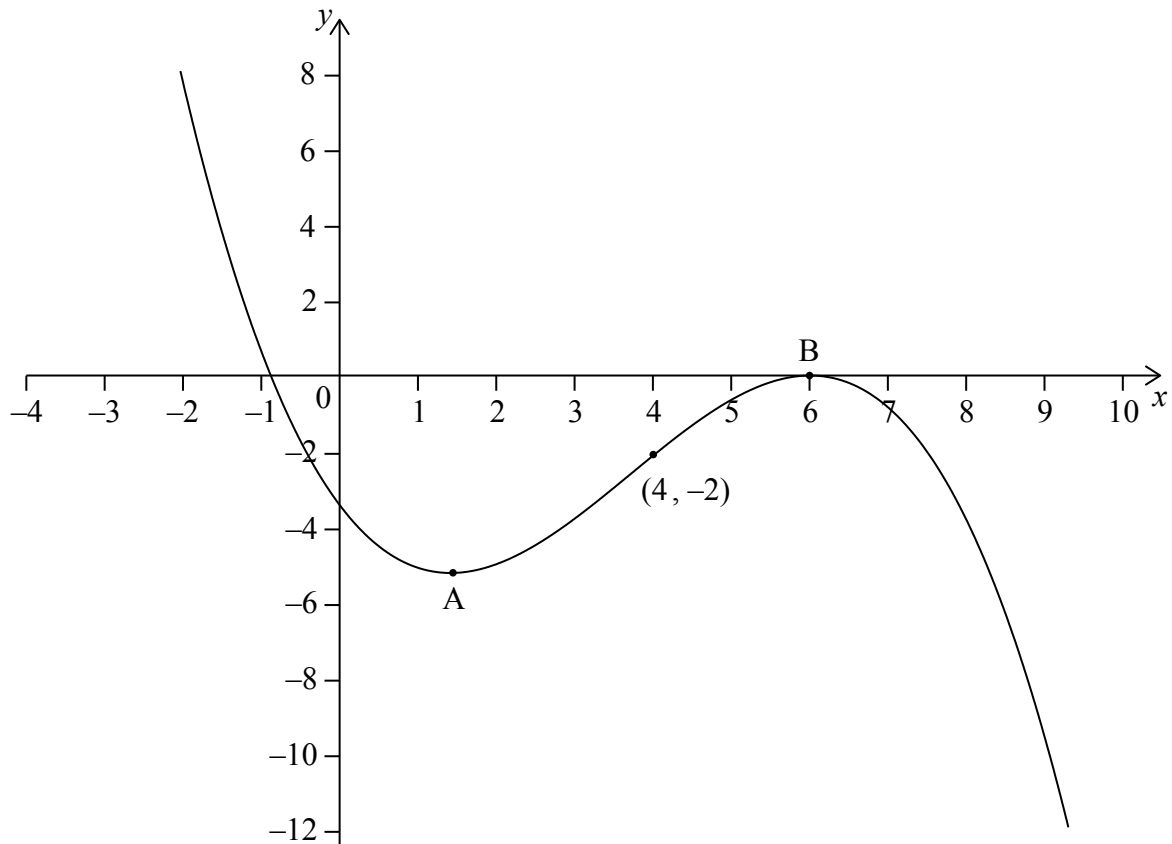(b) Find $f(x)$, given that $f'(x) = x e^{x^2-1}$ and $f(-1) = 3$. [3]

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]

(This question continues on the following page)

(Question 6 continued)

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 $\displaystyle\sum_{k=1}^{\infty} 2^{5-k} \ln x = 64$.   [5]

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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 $\overrightarrow{AB}$.

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

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

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]

Turn over

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 θ.

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

(a)   Show that $\cos\theta = \dfrac{3}{4}$.   [6]

(b)   Given that $\tan\theta > 0$, find $\tan\theta$.   [3]

(c)   Let $y = \dfrac{1}{\cos x}$, for $0 < x < \dfrac{\pi}{2}$. The graph of y between $x = \theta$ and $x = \dfrac{\pi}{4}$ is rotated $360°$ about the x-axis. Find the volume of the solid formed.   [6]