



No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without written permission from the IB.

Additionally, the license tied with this product prohibits commercial use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, is not permitted and is subject to the IB's prior written consent via a license. More information on how to request a license can be obtained from <http://www.ibo.org/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite de l'IB.

De plus, la licence associée à ce produit interdit toute utilisation commerciale de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, n'est pas autorisée et est soumise au consentement écrit préalable de l'IB par l'intermédiaire d'une licence. Pour plus d'informations sur la procédure à suivre pour demander une licence, rendez-vous à l'adresse <http://www.ibo.org/fr/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin que medie la autorización escrita del IB.

Además, la licencia vinculada a este producto prohíbe el uso con fines comerciales de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales— no está permitido y estará sujeto al otorgamiento previo de una licencia escrita por parte del IB. En este enlace encontrará más información sobre cómo solicitar una licencia: <http://www.ibo.org/es/contact-the-ib/media-inquiries/for-publishers/guidance-for-third-party-publishers-and-providers/how-to-apply-for-a-license>.

**Mathematics**  
**Standard level**  
**Paper 1**

Monday 13 May 2019 (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]**.



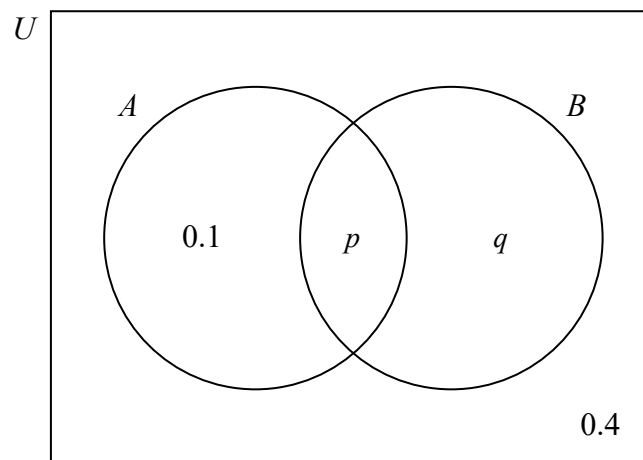
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

### 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]

The following Venn diagram shows the events  $A$  and  $B$ , where  $P(A) = 0.3$ . The values shown are probabilities.



- (a) Find the value of  $p$ . [2]
- (b) Find the value of  $q$ . [2]
- (c) Find  $P(A' \cup B)$ . [2]

(This question continues on the following page)









4. [Maximum mark: 6]

Let  $f(x) = \frac{2x-1}{x+3}$ ,  $x \neq -3$ .

- (a) Write down the equation of the vertical asymptote of the graph of  $f$ . [1]
- (b) Find  $f^{-1}(x)$ . [3]
- (c) Find the equation of the horizontal asymptote of the graph of  $f^{-1}$ . [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....







Please **do not** write on this page.

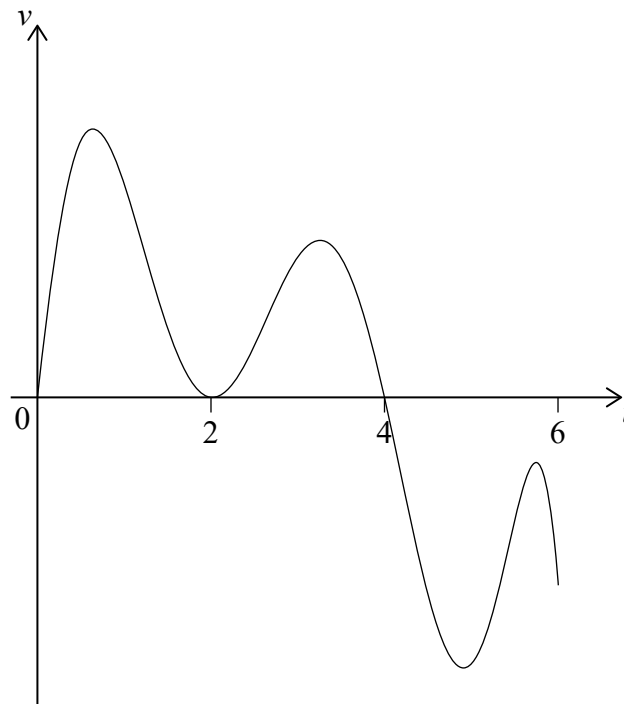
Answers written on this page  
will not be marked.





## 7. [Maximum mark: 7]

A particle P starts from point O and moves along a straight line. The graph of its velocity,  $v \text{ ms}^{-1}$  after  $t$  seconds, for  $0 \leq t \leq 6$ , is shown in the following diagram.



The graph of  $v$  has  $t$ -intercepts when  $t = 0, 2$  and  $4$ .

The function  $s(t)$  represents the displacement of P from O after  $t$  seconds.

It is known that P travels a distance of 15 metres in the first 2 seconds. It is also known that  $s(2) = s(5)$  and  $\int_2^4 v dt = 9$ .

- (a) Find the value of  $s(4) - s(2)$ . [2]
- (b) Find the total distance travelled in the first 5 seconds. [5]

(This question continues on the following page)





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.

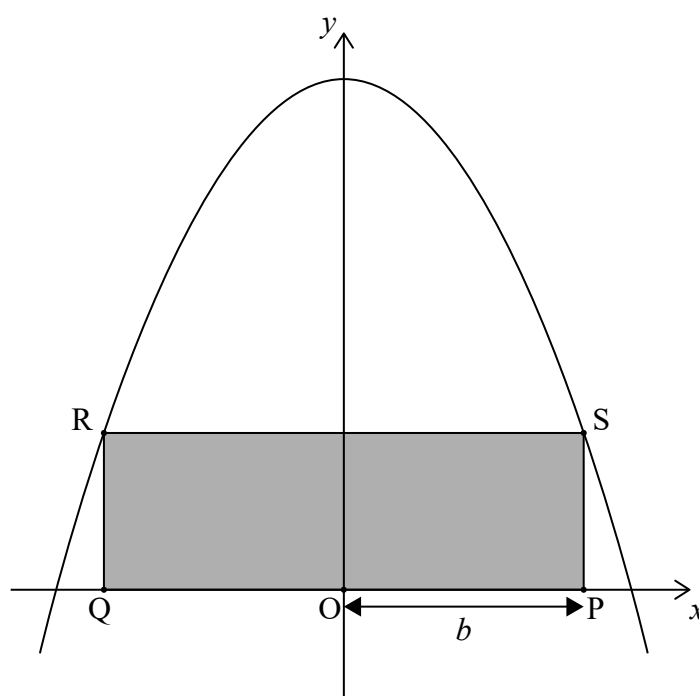
8. [Maximum mark: 16]

Let  $f(x) = 9 - x^2$ ,  $x \in \mathbb{R}$ .

(a) Find the  $x$ -intercepts of the graph of  $f$ .

[2]

The following diagram shows part of the graph of  $f$ .



Rectangle PQRS is drawn with P and Q on the  $x$ -axis and R and S on the graph of  $f$ .

Let  $OP = b$ .

(b) Show that the area of PQRS is  $18b - 2b^3$ .

[2]

(c) Hence find the value of  $b$  such that the area of PQRS is a maximum.

[5]

Consider another function  $g(x) = (x - 3)^2 + k$ ,  $x \in \mathbb{R}$ .

(d) Show that when the graphs of  $f$  and  $g$  intersect,  $2x^2 - 6x + k = 0$ .

[2]

(e) Given that the graphs of  $f$  and  $g$  intersect only once, find the value of  $k$ .

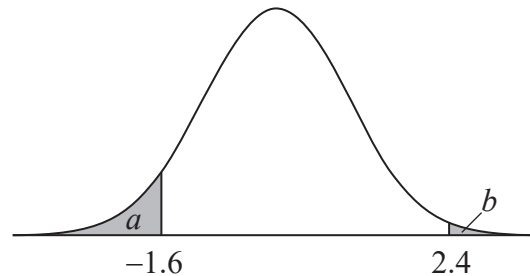
[5]



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

9. [Maximum mark: 13]

A random variable  $Z$  is normally distributed with mean 0 and standard deviation 1. It is known that  $P(z < -1.6) = a$  and  $P(z > 2.4) = b$ . This is shown in the following diagram.



- (a) Find  $P(-1.6 < z < 2.4)$ . Write your answer in terms of  $a$  and  $b$ . [2]
- (b) Given that  $z > -1.6$ , find the probability that  $z < 2.4$ . Write your answer in terms of  $a$  and  $b$ . [4]

A second random variable  $X$  is normally distributed with mean  $m$  and standard deviation  $s$ .

It is known that  $P(x < 1) = a$ .

- (c) Write down the standardized value for  $x = 1$ . [1]

It is also known that  $P(x > 2) = b$ .

- (d) Find  $s$ . [6]



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

10. [Maximum mark: 17]

Consider  $f(x) = \sqrt{x} \sin\left(\frac{\pi}{4}x\right)$  and  $g(x) = \sqrt{x}$  for  $x \geq 0$ . The first time the graphs of  $f$  and  $g$  intersect is at  $x = 0$ .

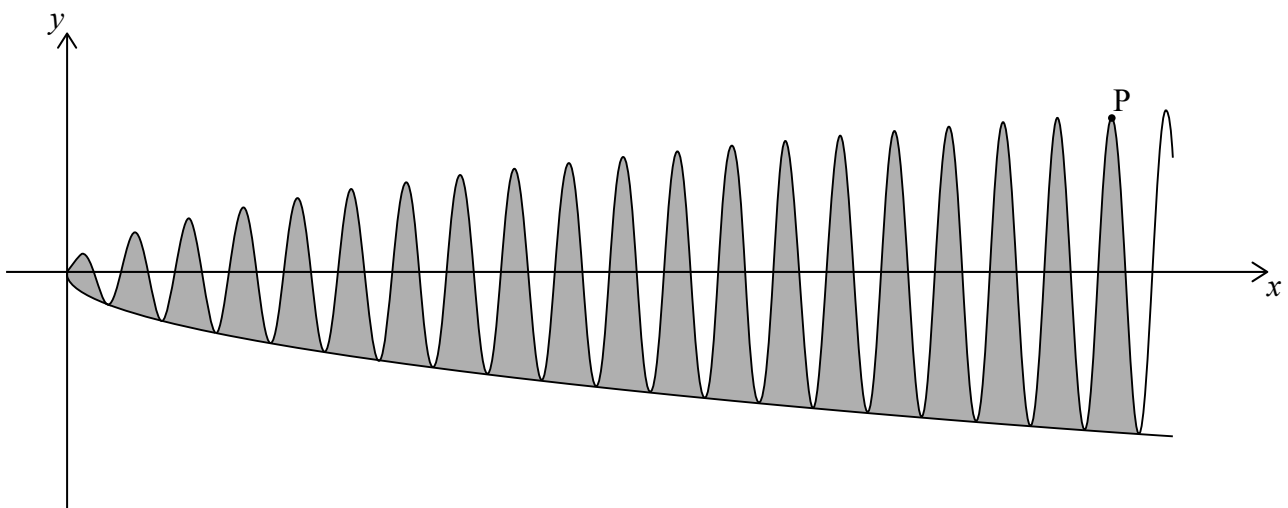
(a) Find the **two** smallest non-zero values of  $x$  for which  $f(x) = g(x)$ . [5]

The set of all non-zero values that satisfy  $f(x) = g(x)$  can be described as an arithmetic sequence,  $u_n = a + bn$  where  $n \geq 1$ .

(b) Find the value of  $a$  and of  $b$ . [4]

(c) At point P, the graphs of  $f$  and  $g$  intersect for the 21st time. Find the coordinates of P. [4]

The following diagram shows part of the graph of  $g$  **reflected** in the  $x$ -axis. It also shows part of the graph of  $f$  and the point P.



(d) Find an expression for the area of the shaded region. Do not calculate the value of the expression. [4]



Please **do not** write on this page.

Answers written on this page  
will not be marked.





Please **do not** write on this page.

Answers written on this page  
will not be marked.

