

**Mathematics**  
**Standard Level**  
**Paper 1**

Name

Date: \_\_\_\_\_

1 hour 30 minutes

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**Instructions to candidates**

- Write your name in the box 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 of Section A in the spaces provided.
- Section B: answer all of Section B on the answer sheets provided. Write your name on each answer sheet and attach them to this examination paper.
- Unless otherwise stated in the question, all numerical answers must be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: analysis and approaches formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

**exam: 9 pages**



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: 6]

The graph of a parabola has  $x$ -intercepts at  $(-3,0)$  and  $(1,0)$ .

- (a) Determine the equation of the axis of symmetry of the parabola. [2]
- (b) An equation for the parabola can be written in the form  $y = ax^2 + bx + c$ . Given that the parabola passes through  $(0,-6)$ , find the value of  $a$ , the value of  $b$ , and the value of  $c$ . [4]

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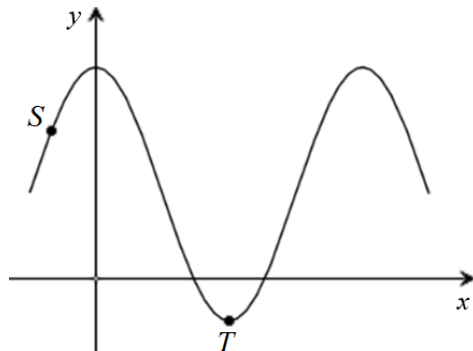
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2. [Maximum mark: 6]

The diagram below shows a curve with equation  $y = 2 + k \cos x$ , defined for  $-\frac{\pi}{2} \leq x \leq \frac{5\pi}{2}$ .



The point  $S$  lies on the curve and has coordinates  $\left(-\frac{\pi}{3}, \frac{7}{2}\right)$ . The point  $T$  with coordinates  $(a, b)$  is the minimum point.

- (a) Show that  $k = 3$ . [2]
- (b) Hence, find the value of  $a$  and the value of  $b$ . [4]

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**3.** [Maximum mark: 6]

A geometric series has a positive common ratio  $r$ . The series has a sum to infinity of 9 and the sum of the first two terms is 5. Find the first three terms of the series.

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5. [Maximum mark: 7]

Solve for  $x$  in each of the following equations:

(a)  $\log_2(5x^2 - x - 2) = 2 + 2\log_2 x$ . [3]

(b)  $3^{x+1} = 2^{2-x}$ . Express the answer in the form  $\frac{\ln a}{\ln b}$ ,  $a, b \in \mathbb{Q}$ . [4]

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**6.** [Maximum mark: 6]

The coefficients of  $x^2$  in the expansions  $(1+x)^{2n}$  and  $(1+15x^2)^n$  are equal. Given that  $n$  is a positive integer, find the value of  $n$ .

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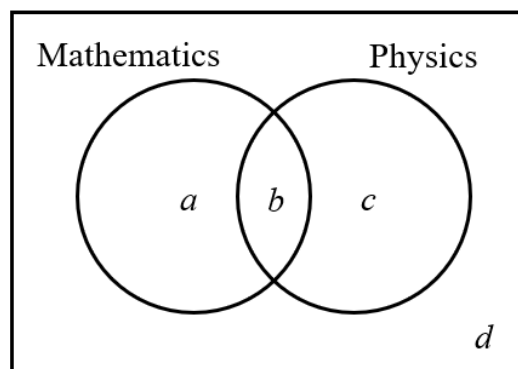
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## Section B

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

7. [Maximum mark: 14]

In a class of 16 students, 12 study Mathematics, 6 study Physics, and 2 study neither Mathematics or Physics. The class is represented by the diagram below.



- (a) (i) Calculate the value of  $a$ , the value of  $b$ , the value of  $c$  and the value of  $d$ . [5]
- (ii) A student is randomly selected from the class. Given that the student studies Physics, show that the probability that the student also studies Mathematics is  $\frac{2}{3}$ . [2]
- (iii) Two students are randomly selected from the class. Find the probability that the first student chosen studies only Mathematics and the second student chosen studies only Physics. [4]
- (b) Two students are randomly selected from the class and moved to a different class. Find the probability that the remaining class of 14 students has no students that studies only Physics. [3]



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

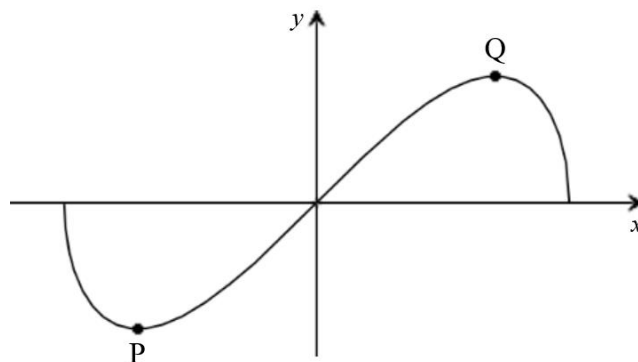
8. [Maximum mark: 19]

The velocity  $v$ , in  $\text{ms}^{-1}$ , of an object moving along a straight line at time  $t$  seconds is given by  $v(t) = 2t^2 - 4t - 6 \text{ ms}^{-1}$ ,  $0 \leq t \leq 4$ . At  $t = 0$  seconds, the displacement of the object is  $s = 0$  m.

- (a) (i) Determine the value of  $t$  at which the object reaches its minimum velocity.
- (ii) Show that the displacement of the object at this value of  $t$  is  $-\frac{22}{3}$  m. [7]
- (b) (i) Sketch a graph of  $v(t)$ , clearly labelling all axis intercepts, maxima and minima.
- (ii) Write down the interval of time during which the object is moving to the right.
- (iii) Write down the interval of time during which the object is moving to the left. [8]
- (c) Find the distance travelled by the object from  $t = 0$  to  $t = 2$  seconds. [4]

9. [Maximum mark: 10]

The diagram shows the graph of the function defined by  $f(x) = x\sqrt{1-x^2}$ ,  $-1 \leq x \leq 1$ .



The function has a minimum at the point P and a maximum at point Q.

- (a) Show that  $f'(x) = \frac{1-2x^2}{\sqrt{1-x^2}}$ . [4]
- (b) Find the coordinates of P, and the coordinates of Q. [4]
- (c) Given that the function  $g$  is defined as  $g(x) = 2f(x-3)$ , determine the range of  $g$ . [2]