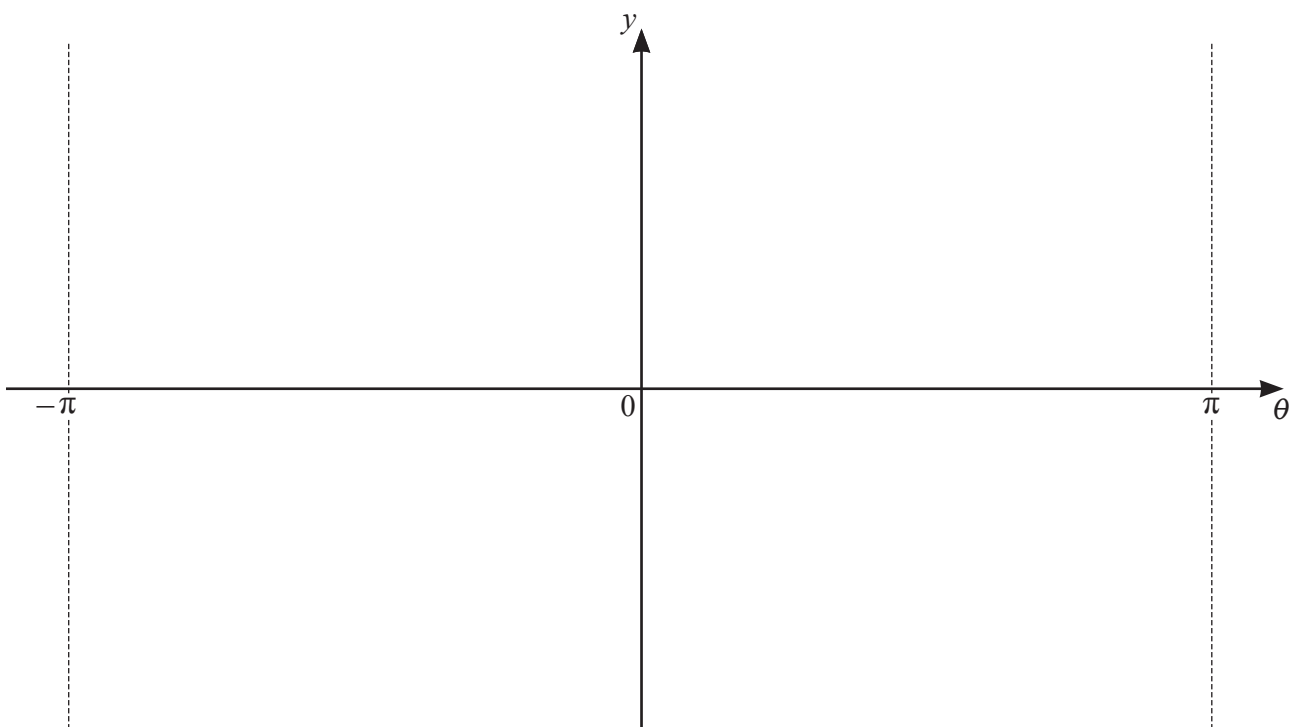




- 1 (a) Write down the period, in radians, of  $3 \tan \frac{\theta}{2} - 3$ . [1]

7

- (b) On the axes, sketch the graph of  $y = 3 \tan \frac{\theta}{2} - 3$  for  $-\pi \leq \theta \leq \pi$ , stating the coordinates of the points where the graph meets the axes. [3]



2 (a) Write  $2x^2 + 5x + 3$  in the form  $2(x+a)^2 + b$ , where  $a$  and  $b$  are rational numbers. [2]



(b) Hence write down the coordinates of the stationary point on the curve  $y = 2x^2 + 5x + 3$ . [2]

(c) Solve the inequality  $2x^2 + 5x + 3 < \frac{15}{8}$ . [3]

- 3 (a) Write  $3 + 2 \lg a - \frac{1}{2} \lg(4b^2)$ , where  $a$  and  $b$  are both positive, as a single logarithm to base 10. Give your answer in its simplest form. [3]

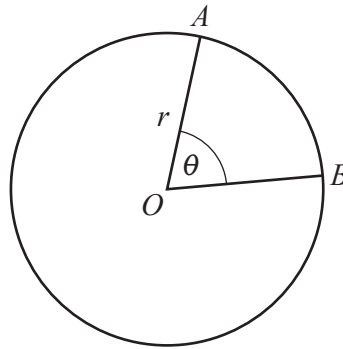
- (b) Given that  $2 \log_c 3 = 7 + 4 \log_3 c$ , find the possible values of the positive constant  $c$ , giving your answers in exact form. [5]

- 4 The straight line  $y = 3x - 11$  and the curve  $xy = 4 - 3x - 2x^2$  intersect at the points  $A$  and  $B$ .  
The point  $C$ , with coordinates  $(a, -8)$  where  $a$  is a constant, lies on the perpendicular bisector of the line  $AB$ . Find the value of  $a$ . [8]

- 5 (a) Find the first three terms in the expansion of  $\left(x^2 - \frac{4}{x^2}\right)^{10}$  in descending powers of  $x$ . Give each term in its simplest form. [3]

- (b) Hence find the coefficient of  $x^{16}$  in the expansion of  $\left(x^2 - \frac{4}{x^2}\right)^{10} \left(x^2 + \frac{2}{x^2}\right)^2$ . [3]

6 In this question lengths are in centimetres and angles are in radians.



The diagram shows a circle with centre  $O$  and radius  $r$ . The points  $A$  and  $B$  lie on the circumference of the circle. The area of the minor sector  $OAB$  is  $25 \text{ cm}^2$ . The angle  $AOB$  is  $\theta$ .

(a) Find an expression for the perimeter,  $P$ , of the minor sector  $AOB$ , in terms of  $r$ . [3]

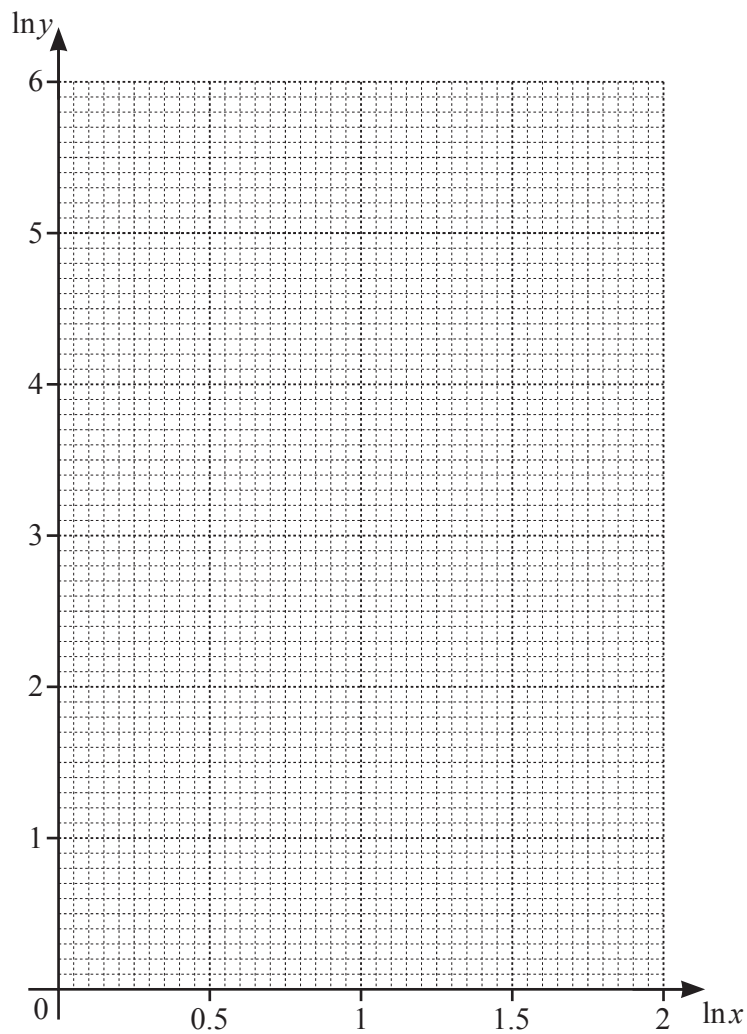
(b) Given that  $r$  can vary, show that  $P$  has a minimum value and find this minimum value. [4]

- 7 The table shows values of the variables  $x$  and  $y$  which are related by an equation of the form  $y = Ax^b$ , where  $A$  and  $b$  are constants.

$x$	1.5	2	2.5	3	4
$y$	13.8	27.5	46.9	72.6	145

- (a) Use the data to draw a straight line graph of  $\ln y$  against  $\ln x$ .

[3]

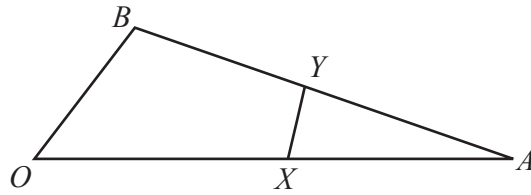


(b) Use your graph to estimate the values of  $A$  and  $b$ .

[5]

(c) Estimate the value of  $x$  when  $y = 100$ .

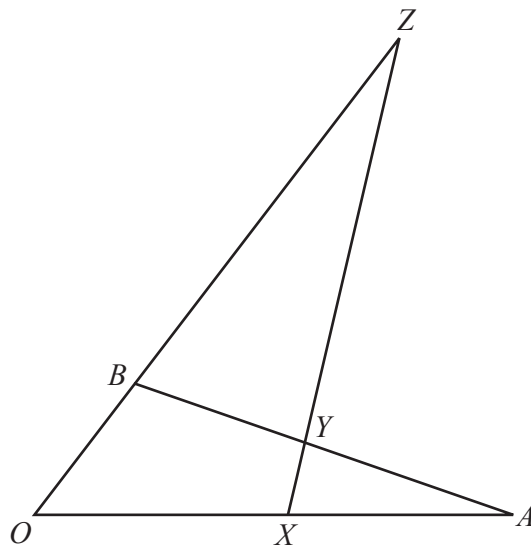
[2]



The diagram shows the triangle  $OAB$  with  $\vec{OA} = \mathbf{a}$  and  $\vec{OB} = \mathbf{b}$ . The point  $X$  lies on the line  $OA$  such that  $\vec{OX} = \frac{3}{5}\mathbf{a}$ . The point  $Y$  is the mid-point of the line  $AB$ . Find, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ ,

(a)  $\vec{AB}$  [1]

(b)  $\vec{XY}$ . [2]



The lines  $OB$  and  $XY$  are extended to meet at the point  $Z$ . It is given that  $\vec{YZ} = \lambda\vec{XY}$  and  $\vec{BZ} = \mu\mathbf{b}$ .

(c) Find  $\overrightarrow{XZ}$  in terms of  $\lambda$ ,  $\mathbf{a}$  and  $\mathbf{b}$ . [2]

(d) Find  $\overrightarrow{XZ}$  in terms of  $\mu$ ,  $\mathbf{a}$  and  $\mathbf{b}$ . [2]

(e) Hence find the values of  $\lambda$  and  $\mu$ . [3]

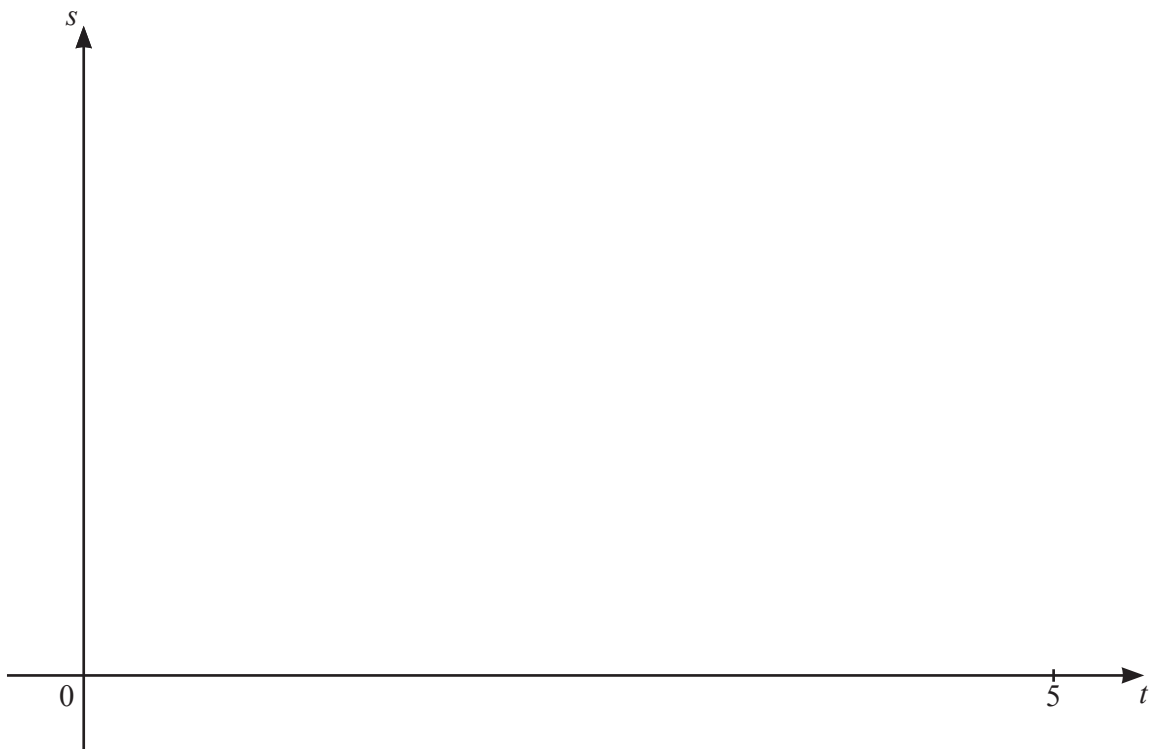
9 In this question lengths are in centimetres and time is in seconds.



A particle  $P$  moves in a straight line such that its displacement  $s$ , from a fixed point at a time  $t$ , is given by  $s = 3(t+2)(t-4)^2$  for  $0 \leq t \leq 5$ .

(a) Find the values of  $t$  for which the velocity,  $v$ , of  $P$  is zero. [4]

(b) On the axes below, sketch the displacement–time graph of  $P$ , stating the intercepts with the axes. [3]



- (c) On the axes below, sketch the velocity–time graph of  $P$ , stating the intercepts with the axes. [2]



- (d) (i) Find an expression for the acceleration of  $P$  at time  $t$ . [1]

- (ii) Hence, on the axes below, sketch the acceleration–time graph of  $P$ , stating the intercepts with the axes. [2]



10 (a) Show that  $\cos^4\theta - \sin^4\theta + 1 = 2\cos^2\theta$ .

[3]

(b) Solve the equation  $\cos^4\frac{\phi}{3} - \sin^4\frac{\phi}{3} + 1 = \frac{1}{2}$ , for  $-3\pi < \phi < 3\pi$ , giving your answers in terms of  $\pi$ . [5]