

1 Find the set of values of  $m$  for which the line with equation  $y = mx + 1$  and the curve with equation  $y = 3x^2 + 2x + 4$  intersect at two distinct points. [4]

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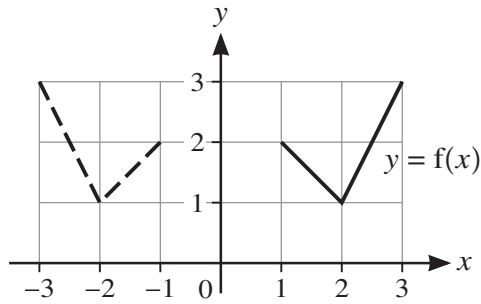
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3 In each of parts (a), (b) and (c), the graph shown with solid lines has equation  $y = f(x)$ . The graph shown with broken lines is a transformation of  $y = f(x)$ .

(a)

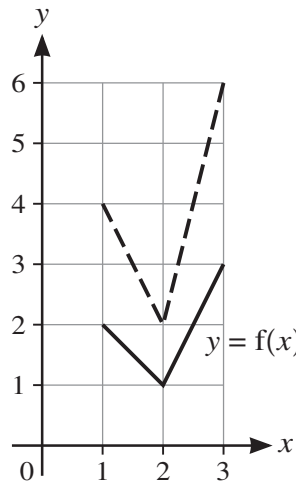


State, in terms of  $f$ , the equation of the graph shown with broken lines.

[1]

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(b)

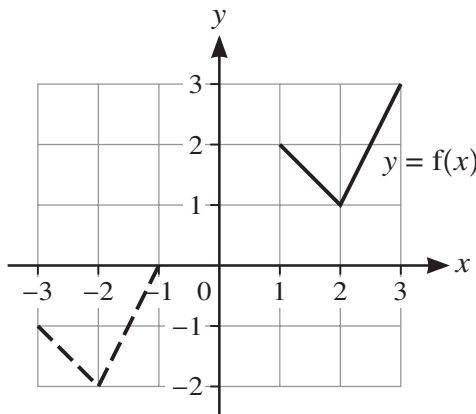


State, in terms of  $f$ , the equation of the graph shown with broken lines.

[1]

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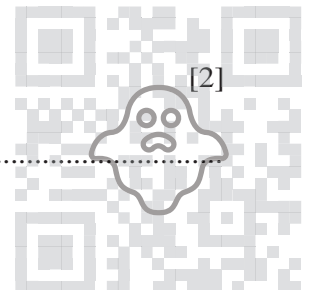
(c)



State, in terms of  $f$ , the equation of the graph shown with broken lines.

[2]

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4 (a) Expand  $(1 + a)^5$  in ascending powers of  $a$  up to and including the term in  $a^3$ . [1]

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(b) Hence expand  $[1 + (x + x^2)]^5$  in ascending powers of  $x$  up to and including the term in  $x^3$ , simplifying your answer. [3]

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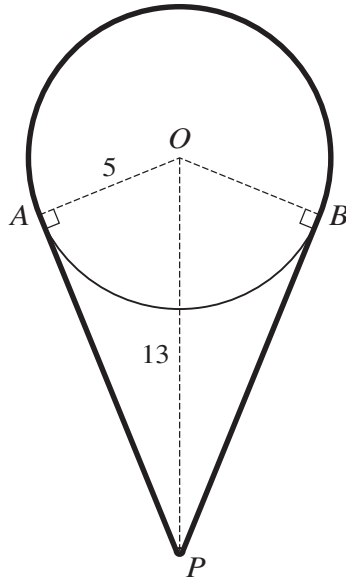
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The diagram shows a cord going around a pulley and a pin. The pulley is modelled as a circle with centre  $O$  and radius  $5$  cm. The thickness of the cord and the size of the pin  $P$  can be neglected. The pin is situated  $13$  cm vertically below  $O$ . Points  $A$  and  $B$  are on the circumference of the circle such that  $AP$  and  $BP$  are tangents to the circle. The cord passes over the major arc  $AB$  of the circle and under the pin such that the cord is taut.

Calculate the length of the cord.

[6]

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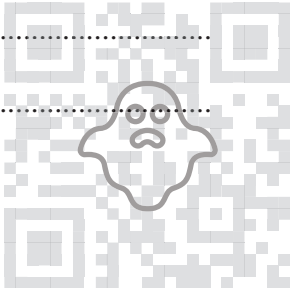
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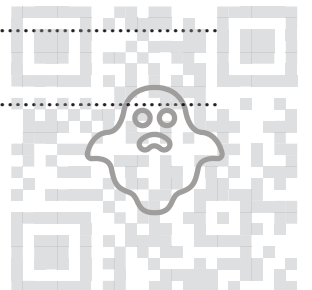
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A series of horizontal dotted lines for writing, spanning most of the page width.





(b) Find the value of  $x$  when the  $y$ -coordinate is increasing at  $\frac{5}{8}$  units per minute. [3]

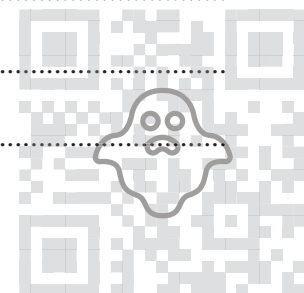
A series of horizontal dotted lines provided for writing the solution to the problem.





7 (a) Show that  $\frac{\tan \theta}{1 + \cos \theta} + \frac{\tan \theta}{1 - \cos \theta} \equiv \frac{2}{\sin \theta \cos \theta}$ . [4]

Dotted lines for writing the solution.







It is now given instead that the progression is arithmetic.

- (b) (i) Find the common difference of the progression in terms of  $\sin \theta$ . [3]

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- (ii) Find the sum of the first 16 terms when  $\theta = \frac{1}{3}\pi$ . [3]

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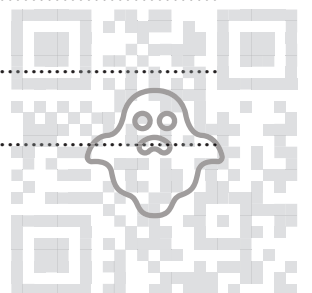
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9 The functions  $f$  and  $g$  are defined by

$$f(x) = x^2 - 4x + 3 \quad \text{for } x > c, \text{ where } c \text{ is a constant,}$$

$$g(x) = \frac{1}{x+1} \quad \text{for } x > -1.$$

(a) Express  $f(x)$  in the form  $(x - a)^2 + b$ . [2]

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It is given that  $f$  is a one-one function.

(b) State the smallest possible value of  $c$ . [1]

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It is now given that  $c = 5$ .

- (c) Find an expression for  $f^{-1}(x)$  and state the domain of  $f^{-1}$ . [3]

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- (d) Find an expression for  $gf(x)$  and state the range of  $gf$ . [3]

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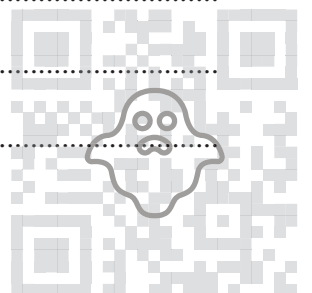
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10 (a) The coordinates of two points  $A$  and  $B$  are  $(-7, 3)$  and  $(5, 11)$  respectively.

Show that the equation of the perpendicular bisector of  $AB$  is  $3x + 2y = 11$ .

[4]

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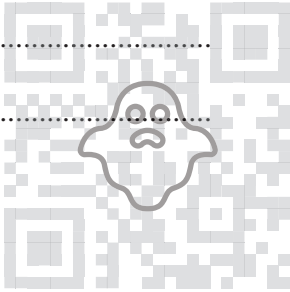
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(b) A circle passes through *A* and *B* and its centre lies on the line  $12x - 5y = 70$ .

Find an equation of the circle. [5]

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