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Surname	Other names
<b>Pearson Edexcel</b> <b>International GCSE</b>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">           Centre Number  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> <div style="text-align: center;">           Candidate Number  <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div> </div> </div>
<h1 style="margin: 0;">Further Pure Mathematics</h1> <h2 style="margin: 0;">Paper 1</h2>	
Friday 13 January 2017 – Morning <b>Time: 2 hours</b>	Paper Reference <b>4PM0/01</b>
<b>Calculators may be used.</b>	Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

### Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

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**Pearson**

**Answer all ELEVEN questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1**

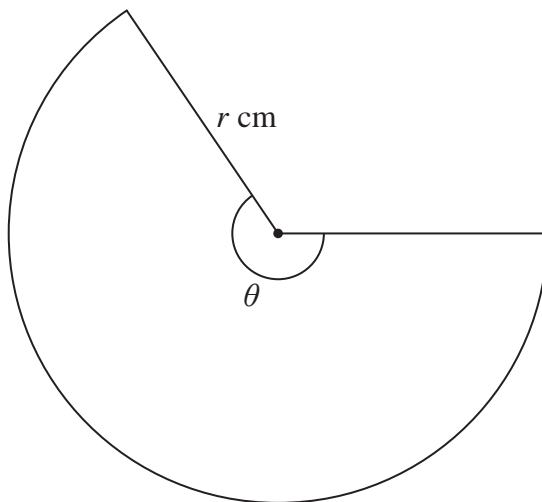


Diagram **NOT**  
accurately drawn

**Figure 1**

Figure 1 shows a sector of a circle. The circle has radius  $r$  cm and the sector has angle  $\theta$  radians. The sector has an arc length of  $18\pi$  cm and an area of  $126\pi$  cm<sup>2</sup>.

Find

- (i) the value of  $r$ ,
- (ii) the exact value of  $\theta$ .

(5)

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(Total for Question 1 is 5 marks)



2

$$f(x) = 2x^3 - 3px^2 + x + 4p \quad \text{where } p \text{ is an integer.}$$

Given that  $(x - 4)$  is a factor of  $f(x)$

- (a) show that the value of  $p$  is 3 (2)

Using this value of  $p$ ,

- (b) find the remainder when  $f(x)$  is divided by  $(x + 2)$  (2)

- (c) factorise  $f(x)$  completely (3)

- (d) solve the equation  $2x^3 - 3px^2 + x + 4p = 0$  (2)

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**Question 2 continued**

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(Total for Question 2 is 9 marks)



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3 Use algebra to find the set of values of  $x$  for which  $(3x - 1)(x - 1) < 2(3x - 1)$

(5)

(Total for Question 3 is 5 marks)



P 4 7 8 7 8 A 0 7 3 6

- 4 The  $n$ th term of a geometric series is  $t_n$  and the common ratio is  $r$ .

Given that  $t_2 + t_5 = \frac{28}{81}$  and  $t_2 - t_5 = \frac{76}{405}$

(a) (i) show that  $r = \frac{2}{3}$

(ii) find the first term of the series.

(6)

(b) Find the sum to infinity of this geometric series.

(2)

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**Question 4 continued**

(Total for Question 4 is 8 marks)



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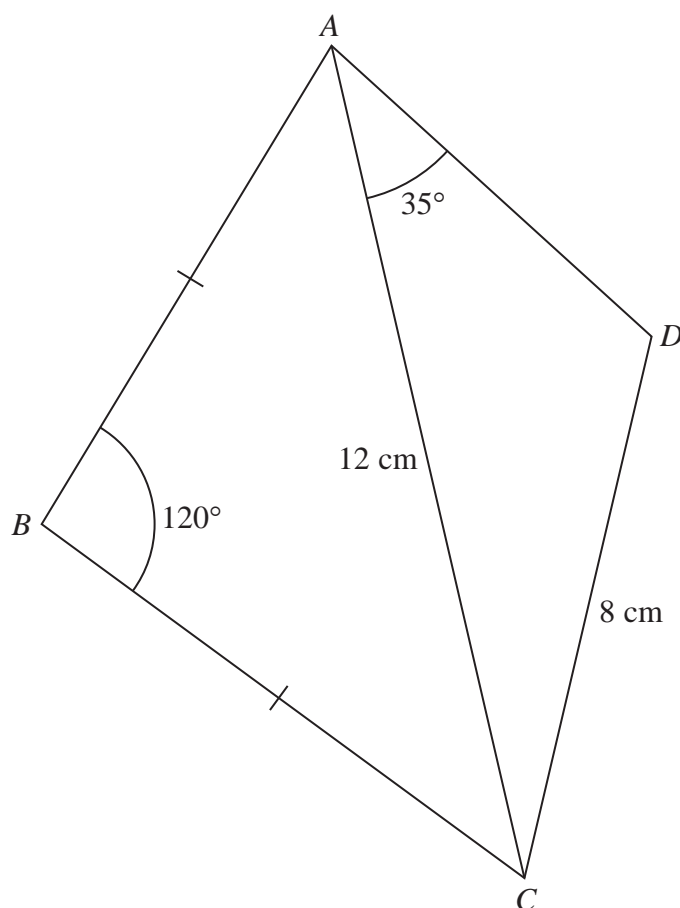
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Figure 2

Figure 2 shows the quadrilateral  $ABCD$  in which  $AB = BC$ .

$DC = 8 \text{ cm}$     $AC = 12 \text{ cm}$     $\angle ABC = 120^\circ$     $\angle CAD = 35^\circ$

Find

(a) the exact length, in cm, of  $AB$ .

(2)

Given that angle  $ADC$  is obtuse, find

(b) the size, in degrees to 1 decimal place, of angle  $ADC$ ,

(3)

(c) the area, in  $\text{cm}^2$  to 3 significant figures, of the quadrilateral  $ABCD$ .

(6)

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**Question 5 continued**

Handwritten solution for Question 5 continued:

Let  $u = \frac{1}{x}$ . Then  $\frac{du}{dx} = -\frac{1}{x^2}$ .

The differential equation becomes  $\frac{du}{dx} = -u^2$ .

Separating variables:  $\frac{du}{u^2} = -dx$ .

Integrating:  $-\frac{1}{u} = -x + C$ .

Substituting back  $u = \frac{1}{x}$ :  $-\frac{1}{\frac{1}{x}} = -x + C$ .

$-x = -x + C$ .

$C = 0$ .

Therefore,  $\frac{1}{x} = 0$ .

$x = \infty$ .



**Question 5 continued**

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**Question 5 continued****(Total for Question 5 is 11 marks)**

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6

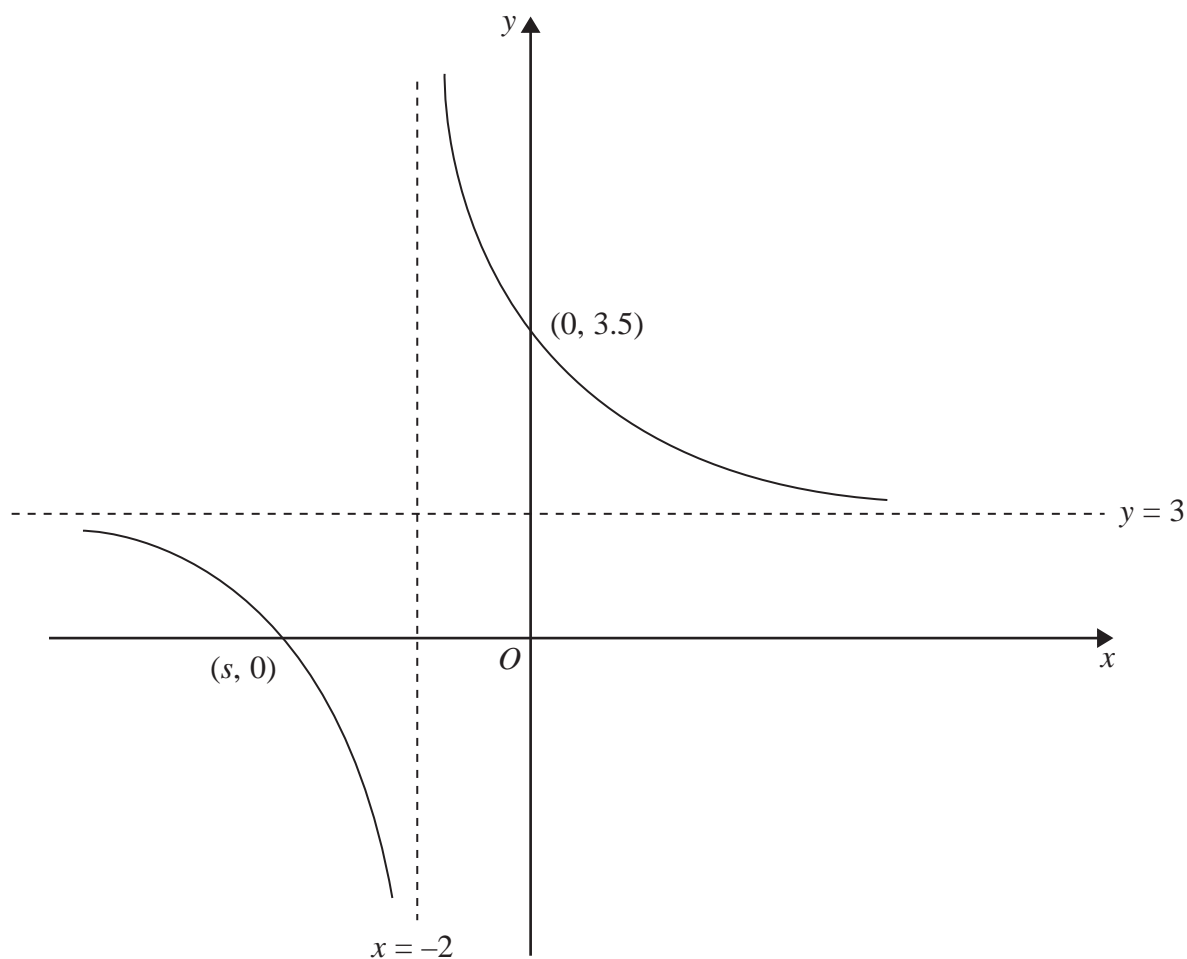


Figure 3

Figure 3 shows a sketch of the curve with equation

$$y = \frac{bx + c}{x + a} \quad x \neq -a,$$

where  $a$ ,  $b$  and  $c$  are integers.

The equations of the asymptotes to the curve are  $x = -2$  and  $y = 3$

The curve crosses the  $y$ -axis at  $(0, 3.5)$

(a) Write down the value of  $a$  and the value of  $b$ .

(2)

(b) Find the value of  $c$ .

(2)

Given that the curve crosses the  $x$ -axis at  $(s, 0)$

(c) find the value of  $s$ .

(2)

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**Question 6 continued**

(Total for Question 6 is 6 marks)



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- 7 (a) Complete the table of values for  $y = \ln(5x + 1) + 2$  giving your answers to 2 decimal places.

$x$	0	1	2	3	4	5	6	7
$y$	2		4.40	4.77	5.04		5.43	

(2)

- (b) On the grid opposite draw the graph of  $y = \ln(5x + 1) + 2$  for  $0 \leq x \leq 7$

(2)

- (c) By drawing an appropriate straight line on the grid, obtain an estimate, to 1 decimal place, of the positive root of the equation  $\ln(5x + 1) - x = 0$  in the interval  $0 \leq x \leq 7$

(3)

- (d) By drawing an appropriate straight line on the grid, obtain an estimate, to 1 decimal place, of the root of the equation  $e^{(3x-1)} = 5x + 1$  in the interval  $0 \leq x \leq 7$

(4)

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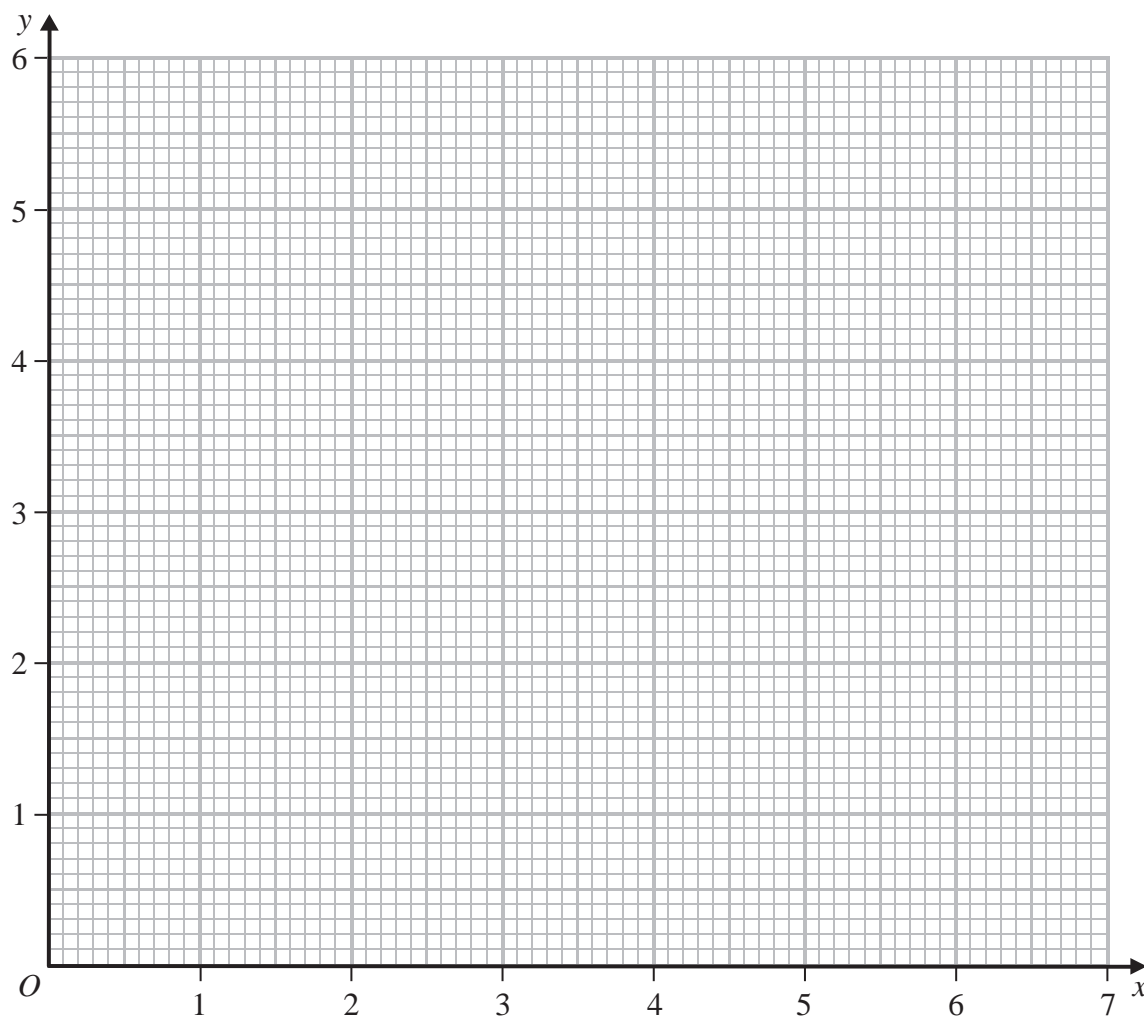
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## Question 7 continued



Turn over for a spare grid if you need to redraw your graph



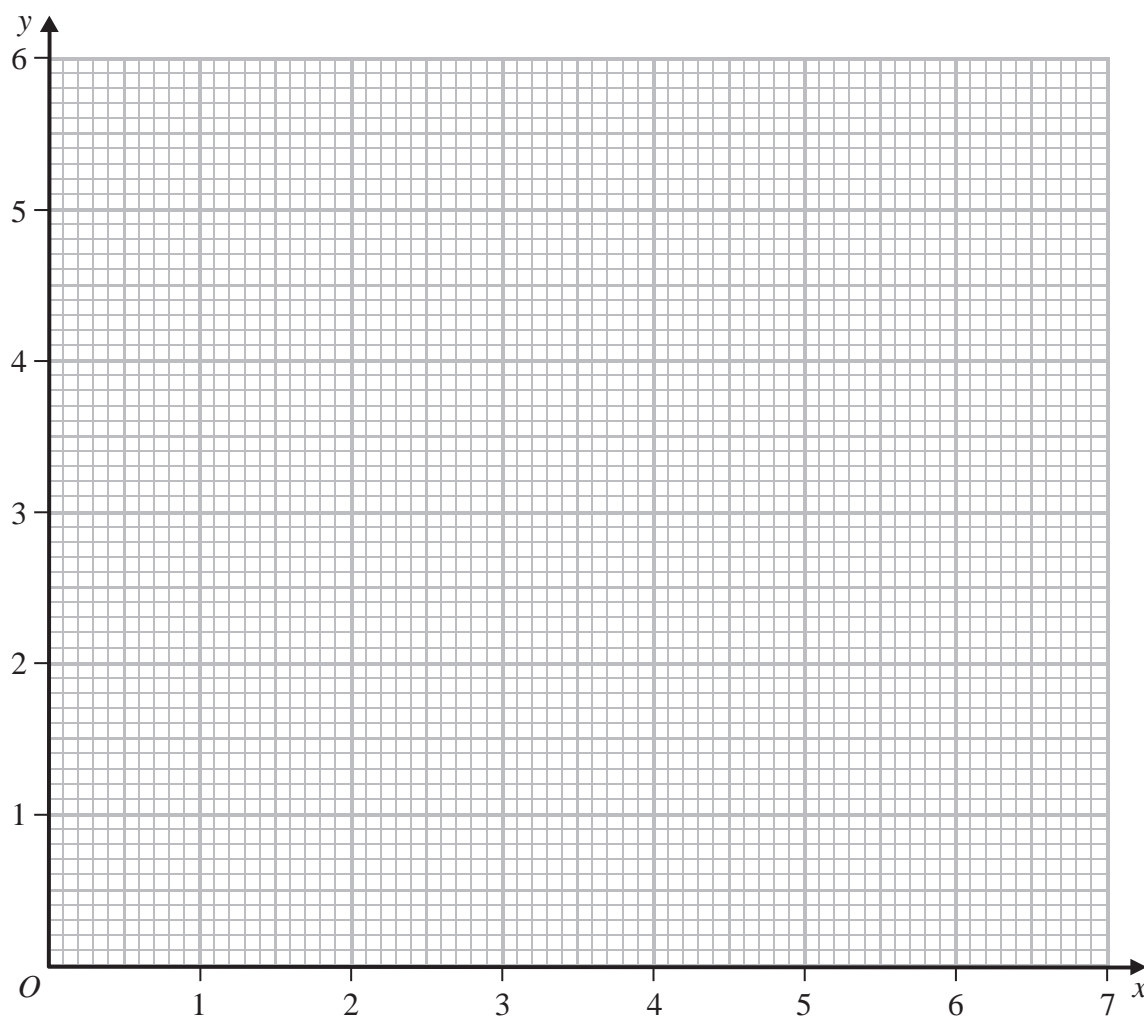
**Question 7 continued**

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**Question 7 continued****Only use this grid if you need to redraw your graph****(Total for Question 7 is 11 marks)**

- 8 (a) (i) Expand  $\left(1 + \frac{x}{2}\right)^{-3}$  in ascending powers of  $x$  up to and including the term in  $x^3$ , expressing each coefficient as an exact fraction in its lowest terms.
- (ii) Find the range of values for which your expression is valid. (4)

- (b) Express  $(2 + x)^{-3}$  in the form  $A(1 + Bx)^{-3}$  where  $A$  and  $B$  are rational numbers whose values should be stated. (2)

$$f(x) = \frac{(1 + 4x)}{(2 + x)^3}$$

- (c) Obtain a series expansion for  $f(x)$  in ascending powers of  $x$  up to and including the term in  $x^2$ . (2)

- (d) Hence obtain an estimate, to 3 significant figures, of  $\int_0^{0.2} \frac{(1 + 4x)}{(2 + x)^3} dx$  (3)

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**Question 8 continued**

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**Question 8 continued**

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(Total for Question 6 is 11 marks)



9 The equation  $3x^2 - 4x + 6 = 0$  has roots  $\alpha$  and  $\beta$ .

(a) Without solving the equation, write down

(i) the value of  $\alpha + \beta$

(ii) the value of  $\alpha\beta$

(2)

(b) Without solving the equation, show that  $\alpha^3 + \beta^3 = -\frac{152}{27}$

(3)

(c) Form a quadratic equation, with integer coefficients, that has roots  $\frac{\alpha}{\beta^2}$  and  $\frac{\beta}{\alpha^2}$

(5)

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**Question 9 continued**

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**Question 9 continued**

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**Question 9 continued****(Total for Question 9 is 10 marks)**

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- 10** A particle  $P$  moves along the positive  $x$ -axis. At time  $t$  seconds ( $t \geq 0$ ) the velocity,  $v$  m/s, of  $P$  is given by  $v = t^3 - 4t^2 + 5t + 1$

The acceleration of  $P$  at time  $t$  seconds is  $a$  m/s<sup>2</sup>

- (a) Find an expression for  $a$  in terms of  $t$ .

(2)

- (b) Find the values of  $t$  for which the magnitude of the acceleration of  $P$  is instantaneously zero.

(2)

When  $t = 0$ , the displacement of  $P$  from the origin is 3 m.

- (c) Find the displacement of  $P$  from the origin when  $t = 2$

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**Question 10 continued**

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**Question 10 continued**

(Total for Question 10 is 9 marks)



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**11** The curve  $C$  has equation  $y = px + qx^2$  where  $p$  and  $q$  are integers.

The curve  $C$  has a stationary point at  $(3, 9)$ .

(a) (i) Show that  $p = 6$  and find the value of  $q$ .

(ii) Determine the nature of the stationary point at  $(3, 9)$ .

(7)

The straight line  $l$  with equation  $y + x - 10 = 0$  intersects  $C$  at two points.

(b) Determine the  $x$  coordinate of each of these two points of intersection.

(3)

The finite region bounded by the curve  $C$  and the straight line  $l$  is rotated through  $360^\circ$  about the  $x$ -axis.

(c) Use algebraic integration to find the volume of the solid formed. Give your answer in terms of  $\pi$ .

(5)

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**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

Handwriting practice area with 20 horizontal dotted lines for the answer to Question 11.



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**Question 11 continued**

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(Total for Question 11 is 15 marks)

**TOTAL FOR PAPER IS 100 MARKS**

