

Write your name here	
Surname	Other names
<b>Edexcel</b>	Centre Number
<b>International GCSE</b>	Candidate Number
<h1 style="margin: 0;">Further Pure Mathematics</h1> <h2 style="margin: 0;">Paper 1</h2>	
Thursday 19 January 2012 – 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.

Turn over ►

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**PEARSON**

**Answer all ELEVEN questions**

**Write your answers in the spaces provided**

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

**1** Show that the two lines with equations

$$6x + 4y = -15$$

$$10x - 15y = 9$$

are perpendicular.

**(4)**

**(Total for Question 1 is 4 marks)**



**2** Solve the equation

$$\frac{x}{x+1} - \frac{1}{x+2} = 2$$

Give your answers correct to 3 significant figures.

(4)

(Total for Question 2 is 4 marks)



3 Solve the inequality  $6x^2 - 19x - 7 < 0$

(4)

(Total for Question 3 is 4 marks)



- 4 Find the coefficient of  $x^7$  in the expansion of  $\left(1 + \frac{x}{\sqrt{3}}\right)^{10}$ , giving your answer in the form  $a\sqrt{3}$ , where  $a$  is a rational number.

(4)

(Total for Question 4 is 4 marks)



P 4 0 6 1 6 A 0 5 3 2

**5** Differentiate with respect to  $x$

$$(a) \quad y = x^2 e^x \quad (2)$$

$$(b) \quad y = (x^3 + 2x^2 + 3)^5 \quad (3)$$



**Question 5 continued**

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



**6** For  $x$  radians,

$$y = 3 \cos \frac{x}{2}$$

(a) Complete the table, giving the three missing values correct to 2 decimal places.

(2)

$x$	0	0.5	1	1.5	2	2.5	3	3.5
$y$	3		2.63	2.20		0.95	0.21	

On the axes opposite,

(b) draw the graph of  $y = 3 \cos \frac{x}{2}$  for  $0 \leq x \leq 3.5$

(2)

(c) Using your graph, find an estimate, to 1 decimal place, for the root of the equation

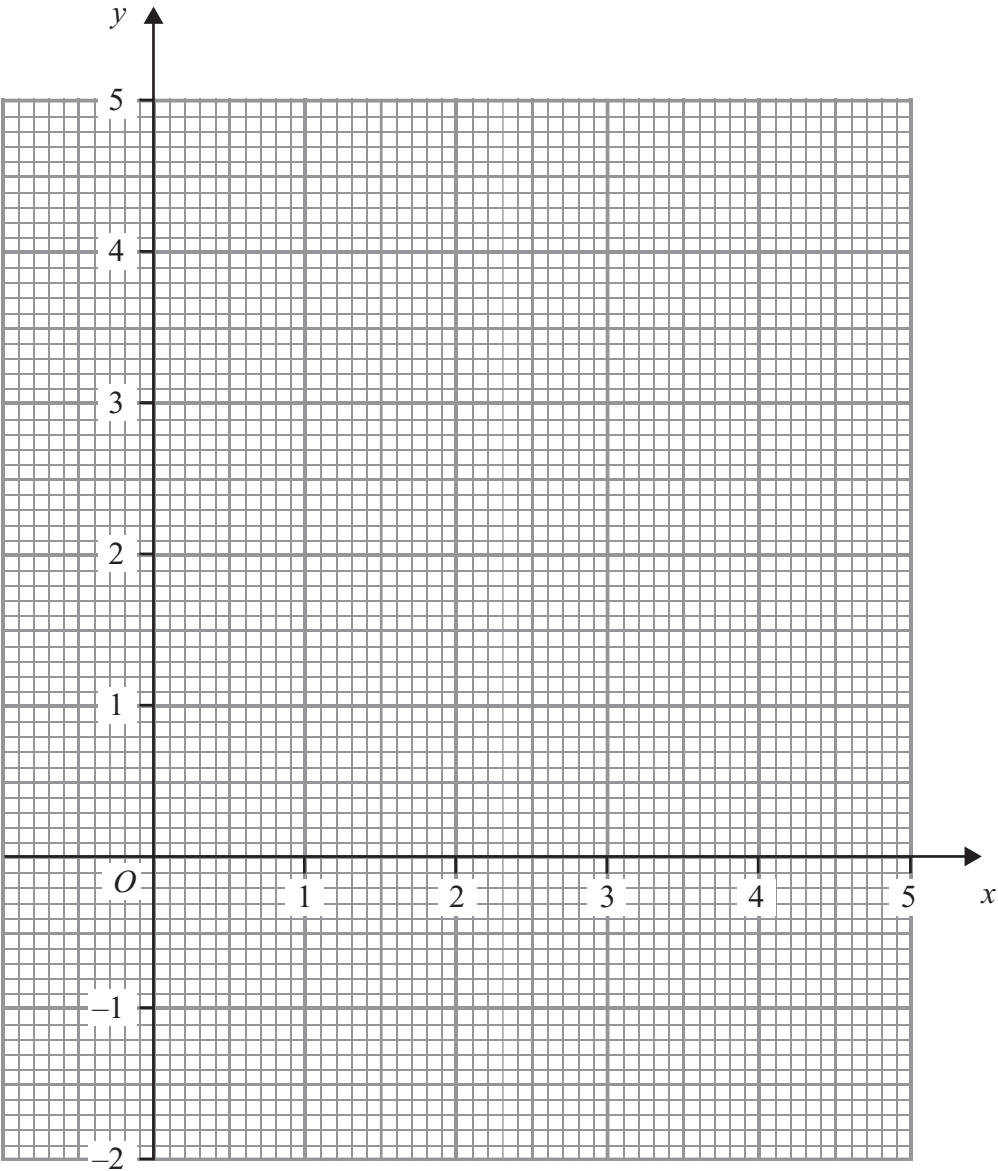
$$2x = 1 + 2 \cos \frac{x}{2}$$

(4)

[illegible]



Question 6 continued

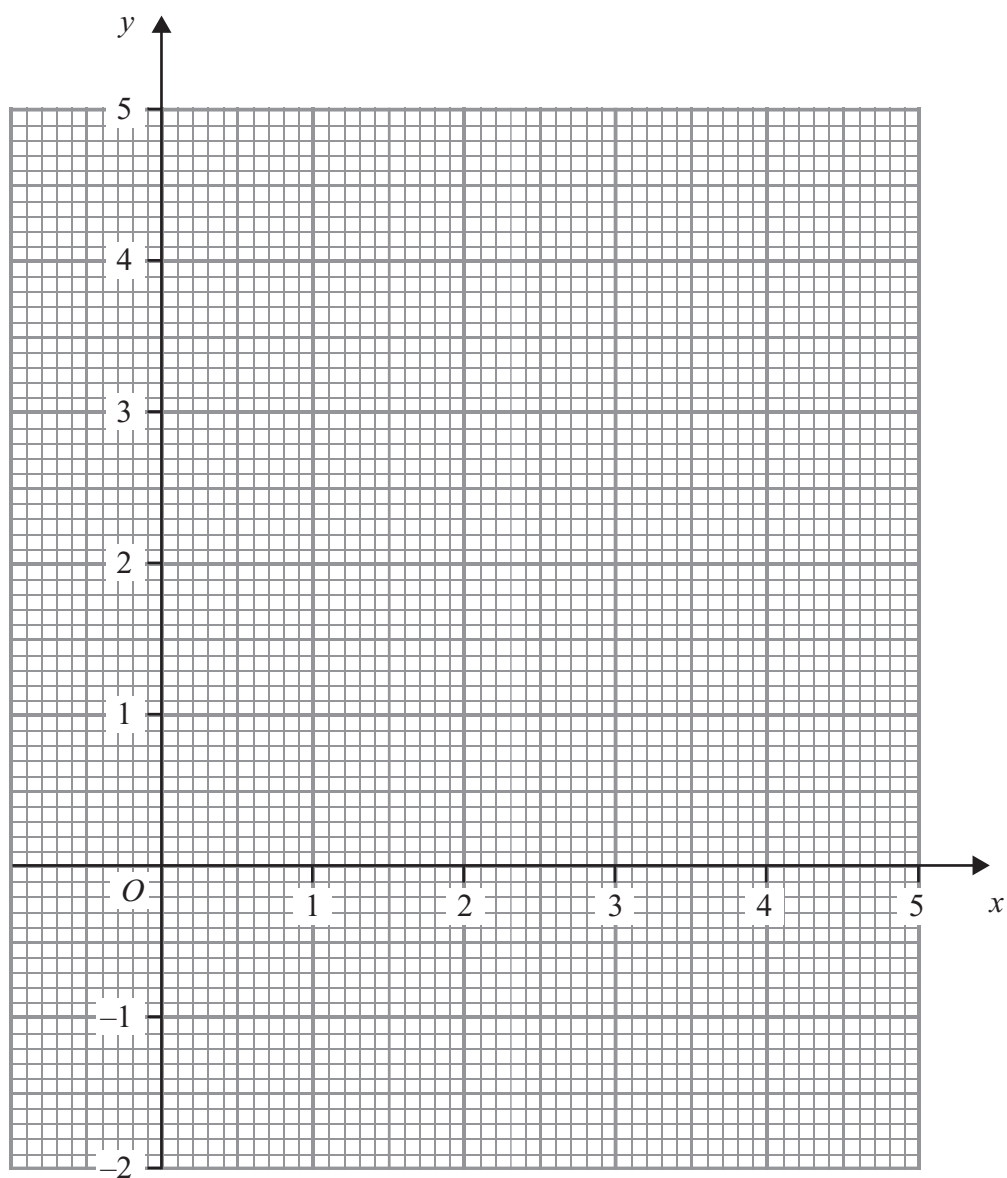


**Question 6 continued**



**Question 6 continued**

Use this page only if you need to redraw your graph.



(Total for Question 6 is 8 marks)





**Question 7 continued**

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**Question 7 continued**

[illegible]

**(Total for Question 7 is 16 marks)**



- (d) Hence find the two possible values of  $m$  (3)

[illegible]



**Question 8 continued**



**Question 8 continued**

[illegible]

**Question 8 continued**

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**(Total for Question 8 is 13 marks)**



9

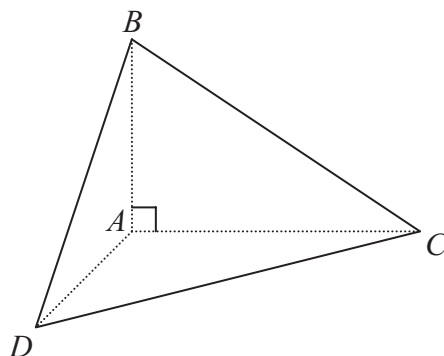
**Figure 1**

Figure 1 shows a triangular pyramid  $ABCD$ .

$$\angle BAC = \angle DAC = \angle BAD = 90^\circ$$

$AD = 5 \text{ cm}$ ,  $AC = 8 \text{ cm}$  and  $AB = 6 \text{ cm}$ .

(a) Find, in degrees to the nearest  $0.1^\circ$ , the size of  $\angle BDC$ .

(6)

(b) Find, to 3 significant figures, the area of triangle  $BDC$ .

(3)

(c) Find the area of triangle  $DAC$ .

(1)

The point  $E$  lies on  $CD$  so that  $AE$  is perpendicular to  $CD$ .

(d) Find the exact length of  $AE$ .

(2)

(e) Hence, or otherwise, find in degrees to the nearest  $0.1^\circ$ , the size of the angle between the planes  $DAC$  and  $BDC$ .

(4)



**Question 9 continued**



**Question 9 continued**

[illegible]

**Question 9 continued**

[illegible]

**(Total for Question 9 is 16 marks)**



10

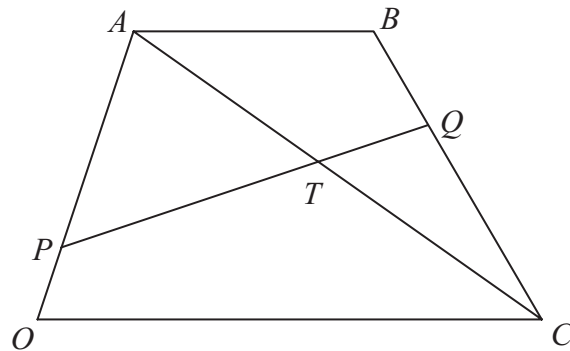
**Figure 2**

Figure 2 shows a trapezium  $OABC$  in which  $AB$  is parallel to  $OC$  and  $AB = \frac{1}{2} OC$ . The point  $P$  divides  $OA$  in the ratio 1:3 and the point  $Q$  divides  $BC$  in the ratio 1:2

The line  $AC$  intersects the line  $PQ$  at the point  $T$ .

$$\overrightarrow{OA} = \mathbf{a} \text{ and } \overrightarrow{OC} = \mathbf{c}$$

(a) Find, as simplified expressions in terms of  $\mathbf{a}$  and  $\mathbf{c}$

(i)  $\overrightarrow{BC}$

(ii)  $\overrightarrow{PQ}$

(5)

(b) (i) Given that  $\overrightarrow{PT} = \lambda \overrightarrow{PQ}$ , find an expression for  $\overrightarrow{AT}$  in terms of  $\lambda$ ,  $\mathbf{a}$  and  $\mathbf{c}$

(ii) Given also that  $\overrightarrow{AT} = \mu \overrightarrow{AC}$ , find an expression for  $\overrightarrow{AT}$  in terms of  $\mu$ ,  $\mathbf{a}$  and  $\mathbf{c}$

(2)

(c) Use your answers from part (b) to find the value of  $\lambda$  and hence write down the ratio  $PT : TQ$

(6)

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**Question 10 continued**



[illegible]

**Question 10 continued**

**(Total for Question 10 is 13 marks)**



11

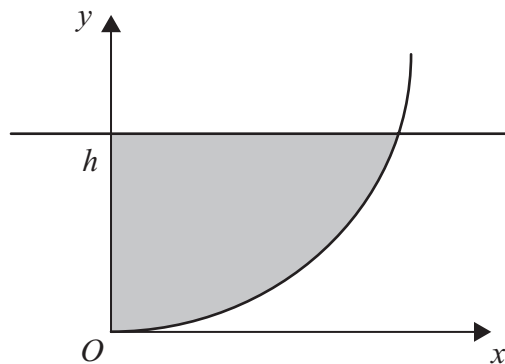


Figure 3

The centre of the circle  $C$ , with equation  $x^2 + y^2 - 10y = 0$ , has coordinates  $(0, 5)$ . The circle passes through the origin  $O$ . The region bounded by the circle, the positive  $y$ -axis and the line  $y = h$ , where  $h < 5$ , is shown shaded in Figure 3. The shaded region is rotated through  $2\pi$  radians about the  $y$ -axis.

- (a) Show that the volume of the solid formed is  $\frac{1}{3}\pi h^2(15 - h)$ .

(5)

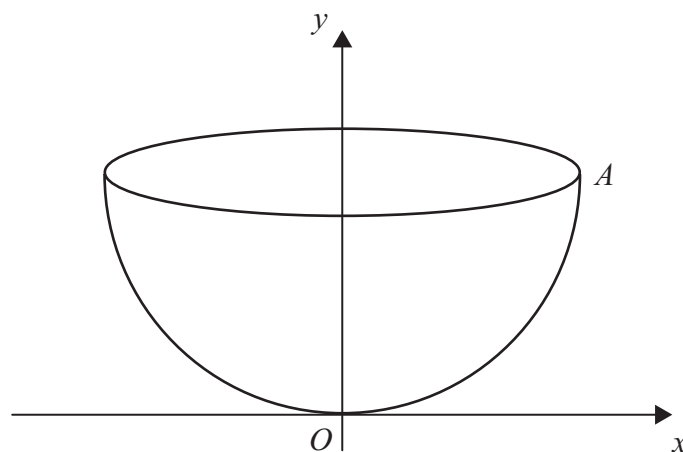


Figure 4

The point  $A$  with coordinates  $(5, 5)$  lies on  $C$ . A bowl is formed by rotating the arc  $OA$  through  $2\pi$  radians about the  $y$ -axis, as shown in Figure 4. Water is poured into the bowl at a constant rate of  $6 \text{ cm}^3/\text{s}$ . The volume of water in the bowl is  $V \text{ cm}^3$  when the depth of water above  $O$  is  $h \text{ cm}$ .

- (b) Use the formula given in part (a) to find an expression for  $\frac{dV}{dh}$  in terms of  $h$ . (1)
- (c) Find, to 3 significant figures, the rate at which  $h$  is changing when the water above  $O$  is 1.5 cm deep. (4)

The area of the surface of the water is  $W \text{ cm}^2$  when the depth of water above  $O$  is  $h \text{ cm}$ .

- (d) Show that, for  $0 < h < 5$ , the rate of change of the depth of water above  $O$  is  $\frac{k}{W}$ , stating the value of  $k$ . (3)



**Question 11 continued**



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**Question 11 continued**

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**TOTAL FOR PAPER IS 100 MARKS**