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Surname	Other names
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**Pearson Edexcel**  
**International GCSE**

Centre Number

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Candidate Number

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**Further Pure Mathematics**  
**Paper 1**

Friday 22 January 2016 – Morning <b>Time: 2 hours</b>	Paper Reference <b>4PM0/01</b>
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**Calculators may be used.**

Total Marks
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### 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 the stages in your working.

1

$$f(x) = 3x^3 + 2\sin x - \frac{4}{x^2} \text{ where } x \neq 0$$

(a) Find  $f'(x)$  (3)

(b) Find  $\int f(x)dx$  (4)

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**Question 1 continued**

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**(Total for Question 1 is 7 marks)**



2 Find the set of values of  $x$  for which  $(2x - 3)^2 > 7x - 3$

(5)

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**Question 2 continued**

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**(Total for Question 2 is 5 marks)**



3 The volume,  $V \text{ cm}^3$ , of a sphere of radius  $r \text{ cm}$  is increasing at the rate of  $60 \text{ cm}^3/\text{s}$ .

Find the rate of increase of the radius, in  $\text{cm/s}$  correct to 2 significant figures, when the volume is  $36000\pi \text{ cm}^3$ .

(7)

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**Question 3 continued**

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**(Total for Question 3 is 7 marks)**



- 4 An arithmetic series has first term  $p$  and common difference  $p$  where  $p \neq 0$   
A geometric series also has first term  $p$ . The common ratio of this geometric series is  $r$ .  
The sum of the first three terms of the arithmetic series is equal to the sum of the first three terms of the geometric series.

Given that  $r > 0$

show that  $r = \frac{-1 + \sqrt{21}}{2}$  (5)

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**Question 4 continued**

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**(Total for Question 4 is 5 marks)**



5 Given that  $\frac{1}{\sqrt{4-x}}$  can be written as  $p(1-qx)^{\frac{1}{2}}$

(a) find the value of  $p$  and the value of  $q$ .

(2)

(b) (i) Find the first four terms in the expansion of  $\frac{1}{\sqrt{4-x}}$  in ascending powers of  $x$ , simplifying each term.

(ii) State the range of values of  $x$  for which this expansion is valid.

(4)

Given that the first three terms of the expansion of  $\frac{2(1+x)}{\sqrt{4-x}}$  are  $a + bx + cx^2$

(c) find the exact value of

(i)  $a$                       (ii)  $b$                       (iii)  $c$

(3)

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**Question 5 continued**

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**Question 5 continued**

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**Question 5 continued**

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**(Total for Question 5 is 9 marks)**



6 Giving your solutions to 3 decimal places, solve the equation

(a)  $\cos x = 0.4$   $-\pi < x < \pi$  (2)

(b)  $\tan\left(2\theta + \frac{\pi}{4}\right) = 1.5$   $0 < \theta < \pi$  (4)

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**Question 6 continued**

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**(Total for Question 6 is 6 marks)**



7

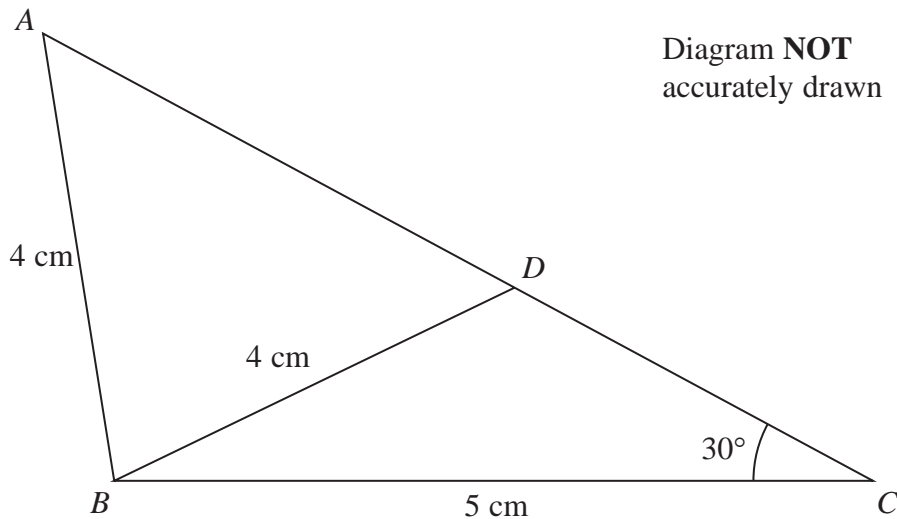


Figure 1

Figure 1 shows the triangle  $ABC$  with  $AB = 4\text{ cm}$ ,  $BC = 5\text{ cm}$  and angle  $BCA = 30^\circ$

The point  $D$  lies on  $AC$  such that  $BD = 4\text{ cm}$  and angle  $BDC$  is obtuse.

Find

- (a) the size of angle  $BDC$ , giving your answer in degrees correct to 1 decimal place, (3)
- (b) the length, in cm, of  $AD$ , giving your answer correct to 3 significant figures, (3)
- (c) the area, in  $\text{cm}^2$ , of triangle  $ABD$ , giving your answer correct to 3 significant figures. (2)

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**Question 7 continued**

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**Question 7 continued**

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**Question 7 continued**

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**(Total for Question 7 is 8 marks)**



- 8 A particle  $P$  is moving along the positive  $x$ -axis. At time  $t$  seconds ( $t \geq 0$ ), the acceleration  $a$  m/s<sup>2</sup> of  $P$  is given by  $a = 6 - 4t$

When  $t = 0$ ,  $P$  is at rest and the displacement of  $P$  from the origin  $O$  is 5 metres.

At time  $t$  seconds, the velocity of  $P$  is  $v$  m/s and the displacement of  $P$  from  $O$  is  $s$  metres.

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

(i)  $v$

(ii)  $s$

(6)

For  $t > 0$ ,  $P$  comes to instantaneous rest at the point  $A$ .

(b) Find

(i) the value of  $t$  when  $P$  reaches  $A$ ,

(ii) the distance  $OA$ .

(5)

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**Question 8 continued**

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**Question 8 continued**

Handwriting practice area with 25 horizontal dotted lines.

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**Question 8 continued**

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**(Total for Question 8 is 11 marks)**



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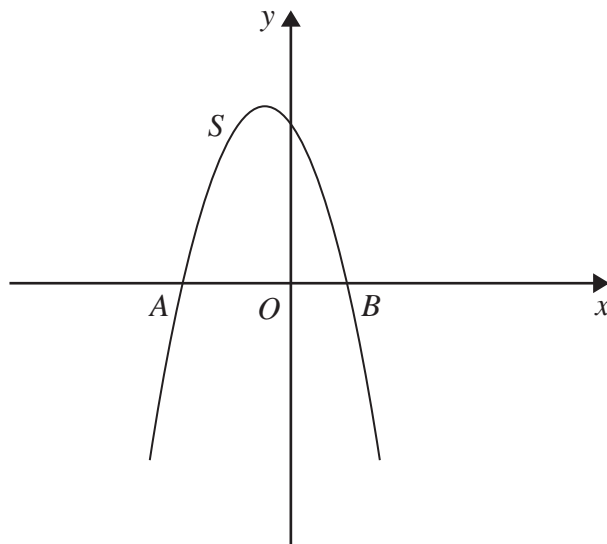


Figure 2

Figure 2 shows the curve  $S$  with equation  $y = 8 - 2x - x^2$

The curve  $S$  crosses the  $x$ -axis at the points  $A$  and  $B$ .

(a) Find the  $x$  coordinate of  $A$  and the  $x$  coordinate of  $B$ . (3)

(b) Use calculus to find the area of the finite region bounded by  $S$  and the  $x$ -axis. (4)

The curve  $T$  with equation  $y = x^2 + x + 6$  intersects  $S$ .

(c) Find the  $x$  coordinates of the points of intersection of  $S$  and  $T$ . (2)

(d) Use calculus to find the area of the finite region bounded by  $S$  and  $T$ . (4)

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**Question 9 continued**

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Question 9 continued

Handwriting practice area with 25 horizontal dotted lines.

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**Question 9 continued**

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**(Total for Question 9 is 13 marks)**





**Question 10 continued**

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**Question 10 continued**

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**Question 10 continued**

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**(Total for Question 10 is 11 marks)**



11

$$f(x) = 4 + 3x - x^2$$

- (a) Write  $f(x)$  in the form  $P - Q(x + R)^2$ , where  $P$ ,  $Q$  and  $R$  are rational numbers. (2)

The curve  $C$  has equation  $y = 4 + 3x - x^2$

- (b) Find the coordinates of the maximum point of  $C$ . (1)

The line  $l_1$  is a tangent to  $C$  at the point where  $x = 1$

- (c) Find an equation for  $l_1$  (5)

Another line  $l_2$  is perpendicular to  $l_1$  and is also a tangent to  $C$ .

The lines  $l_1$  and  $l_2$  intersect at the point  $A$ .

- (d) Find the coordinates of  $A$ . (5)

The point  $B$  with coordinates  $(-3, 2)$  lies on  $l_1$

- (e) Find the exact length of  $AB$ . (2)

The point  $D$  with coordinates  $(8, 0)$  lies on  $l_2$

- (f) Find the exact area of triangle  $ABD$ . (3)

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**(Total for Question 11 is 18 marks)**

**TOTAL FOR PAPER IS 100 MARKS**

