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Surname

Other names

**Pearson Edexcel  
International GCSE**

Centre Number

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Candidate Number

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# Further Pure Mathematics

## Paper 2

Thursday 23 January 2014 – Morning  
**Time: 2 hours**

Paper Reference

**4PM0/02**

**Calculators may be used.**

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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P 4 4 0 2 7 R A 0 1 3 2

**PEARSON**



- 2 The volume of a right circular cone is increasing at a constant rate of  $12 \text{ cm}^3/\text{s}$ . The radius of the base of the cone is always half the height of the cone. Find, in  $\text{cm}/\text{s}$ , the exact value of the rate of increase of the height of the cone when the height is  $4 \text{ cm}$ .

(5)

(Total for Question 2 is 5 marks)



3 Solve the equations

$$x^2 + xy - 3x = 2$$

$$5y + 6x = 22$$

(6)

A series of horizontal dotted lines for writing the solution.





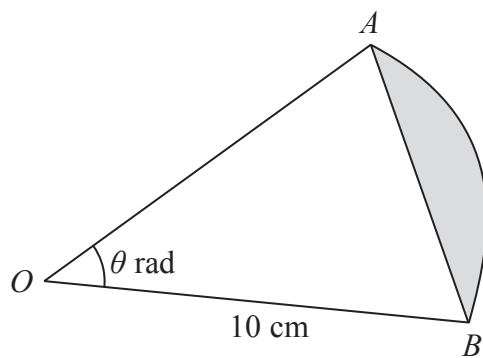


Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows a sector of a circle of radius 10 cm and centre  $O$ . The area of triangle  $OAB$  is  $20 \text{ cm}^2$  and the size of angle  $AOB$  is  $\theta$  radians.

Find, to 3 significant figures,

- (a) the value of  $\theta$ , (2)
- (b) the length of the arc  $AB$ , (2)
- (c) the area of the shaded segment. (3)

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Question 4 continued

A series of horizontal dotted lines for writing.

(Total for Question 4 is 7 marks)



5 A curve  $C$  has equation  $y = \frac{2x - 5}{x + 3}$ ,  $x \neq -3$

(a) Find an equation of the asymptote to  $C$  which is parallel to

- (i) the  $x$ -axis,      (ii) the  $y$ -axis.

(2)

(b) Find the coordinates of the point where  $C$  crosses

- (i) the  $x$ -axis,      (ii) the  $y$ -axis.

(2)

(c) Sketch the graph of  $C$ , showing clearly its asymptotes and the coordinates of the points where the graph crosses the coordinate axes.

(3)

(d) Find the gradient of  $C$  at the point on  $C$  where  $x = -1$

(3)

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**Question 5 continued**

A series of horizontal dotted lines for writing.



**Question 5 continued**

A series of horizontal dotted lines for writing.

**(Total for Question 5 is 10 marks)**



6

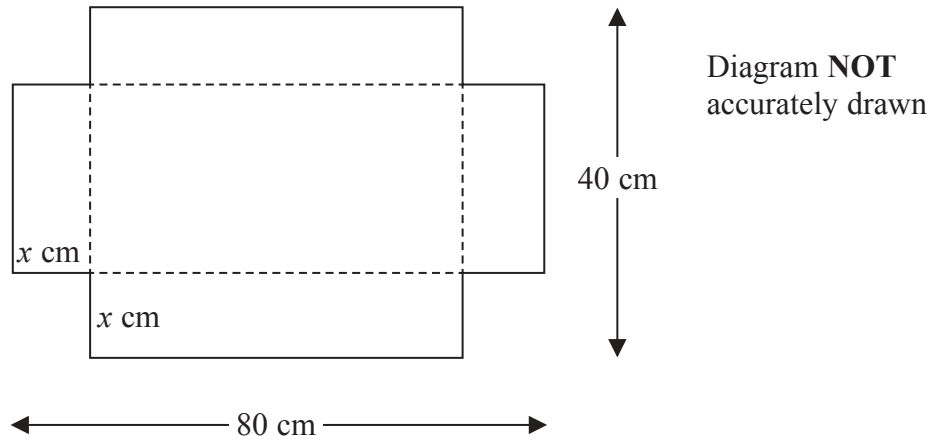


Figure 2

A rectangular sheet of card measures 80 cm by 40 cm. A square of side  $x$  cm is cut away from each corner of the card as shown in Figure 2. The card is then folded along the dotted lines to form an open box.

The volume of the box is  $V$  cm<sup>3</sup>.

- (a) Show that  $V = 3200x - 240x^2 + 4x^3$  (3)
- (b) Find, to 3 significant figures, the value of  $x$  for which  $V$  is a maximum, justifying that this value of  $x$  gives a maximum value of  $V$ . (6)
- (c) Find, to 3 significant figures, the maximum value of  $V$ . (2)

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**Question 6 continued**

A series of horizontal dotted lines for writing.



**Question 6 continued**

Handwriting practice area consisting of 25 horizontal dotted lines.



**Question 6 continued**

A series of horizontal dotted lines provided for writing the answer.

**(Total for Question 6 is 11 marks)**



P 4 4 0 2 7 R A 0 1 5 3 2

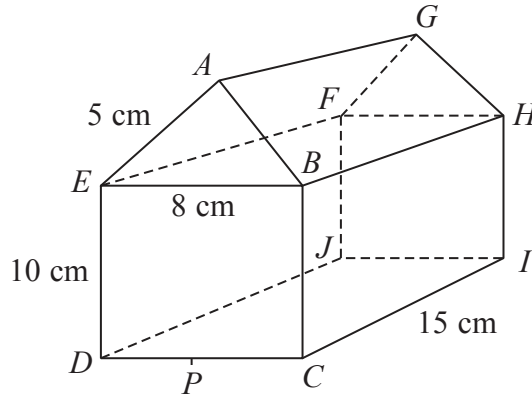


Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows a prism  $ABCDEFGHIJ$  which consists of a triangular prism  $ABEFGH$  on top of a cuboid  $BCDEFHIJ$ .

$$AB = AE = 5 \text{ cm}, \quad EB = 8 \text{ cm}, \quad ED = 10 \text{ cm}, \quad CI = 15 \text{ cm}$$

$P$  is the midpoint of  $DC$ .

Calculate, in cm to 3 significant figures,

(a) the length of  $PG$ , (3)

(b) the length of  $AC$ . (2)

Find, in degrees to the nearest  $0.1^\circ$ ,

(c) the size of the angle between  $PG$  and the plane  $CDJI$ , (3)

(d) the size of the angle between the plane  $AGIC$  and the plane  $CDJI$ . (3)

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**Question 7 continued**

A series of horizontal dotted lines for writing the answer to Question 7.



**Question 7 continued**

A series of horizontal dotted lines for writing.



**Question 7 continued**

Ruled area for writing answers, consisting of multiple horizontal dotted lines.

**(Total for Question 7 is 11 marks)**



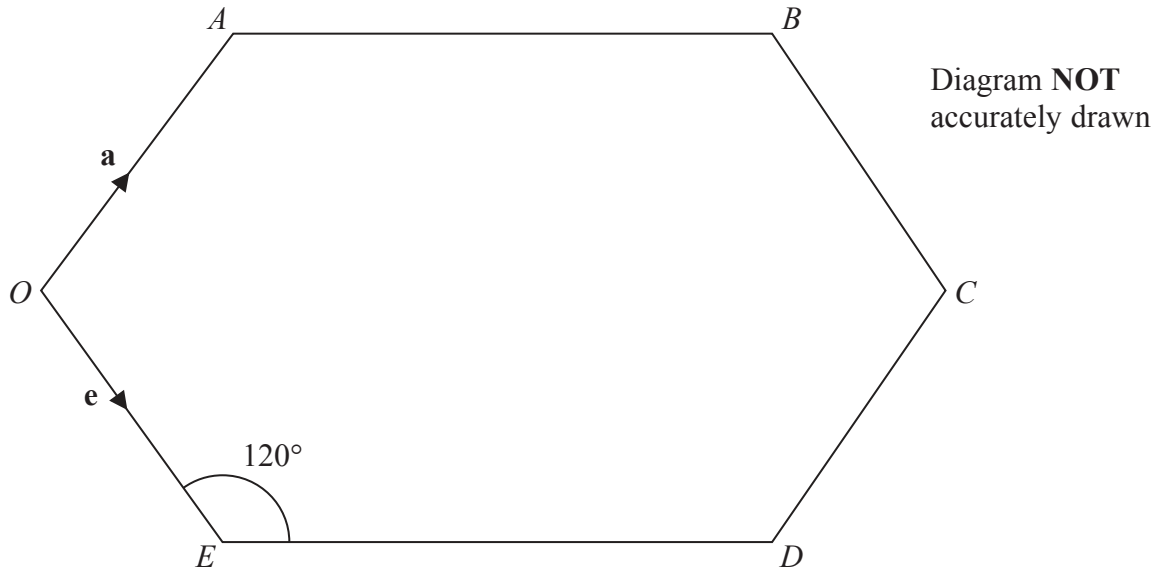


Figure 4

Figure 4 shows a hexagon  $OABCDE$ . Each internal angle of the hexagon is  $120^\circ$ .

$$OA = OE, \quad AB = ED = 2 \times OA \quad \text{and} \quad OC = 3 \times OA$$

$$\vec{OA} = \mathbf{a} \quad \text{and} \quad \vec{OE} = \mathbf{e}.$$

Find as simplified expressions in terms of  $\mathbf{a}$  and  $\mathbf{e}$

(a)  $\vec{AB}$ , (2)

(b)  $\vec{BE}$ . (2)

The point  $P$  divides  $AB$  internally in the ratio 2:3

(c) Find  $\vec{PC}$  as a simplified expression in terms of  $\mathbf{a}$  and  $\mathbf{e}$ . (3)

The point  $Q$  lies on  $ED$  produced so that the points  $P$ ,  $C$  and  $Q$  are collinear.

(d) Find  $\vec{OQ}$  in the form  $\lambda\mathbf{a} + \mu\mathbf{e}$ , stating the value of  $\lambda$  and the value of  $\mu$ . (6)



**Question 8 continued**

Handwriting practice area consisting of 25 horizontal dotted lines.



**Question 8 continued**

A series of horizontal dotted lines for writing answers.



**Question 8 continued**

A series of horizontal dotted lines for writing.

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



- 9 (a) Show that the first four terms of the expansion of  $(1 - x)^{-k}$ ,  $k \neq 0$ , in ascending powers of  $x$  can be written as

$$1 + kx + \frac{k(k+1)}{2}x^2 + \frac{k(k+1)(k+2)}{6}x^3 \quad (3)$$

- (b) Expand  $(1 + kx)^{\frac{1}{2}}$ ,  $k \neq 0$ , in ascending powers of  $x$ , up to and including the term in  $x^3$ , simplifying your terms. (3)

Given that the coefficients of  $x^2$  in the two expansions are equal,

- (c) find the value of  $k$ . (3)

Given that  $\sqrt{15} = \lambda \sqrt{\frac{3}{5}}$

- (d) find the value of  $\lambda$ . (2)

- (e) Hence, using your value of  $k$  and one of your expansions with a suitable value of  $x$ , obtain an approximation for  $\sqrt{15}$  (4)

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**Question 9 continued**

Dotted lines for writing answer.



Question 9 continued

Dotted lines for writing.

(Total for Question 9 is 15 marks)



**10** The sum of the second and third terms of a convergent geometric series is 7.5

The sum to infinity,  $S$ , of the series is 20

The common ratio of the series is  $r$ .

(a) Show that  $r$  is a root of the equation

$$8r^3 - 8r + 3 = 0 \tag{4}$$

(b) Show that  $r = \frac{1}{2}$  is a root of this equation. (1)

Given that  $r < 0.6$

(c) show that  $\frac{1}{2}$  is the only possible value of  $r$ . (4)

(d) Find the first term of the series. (2)

The sum of the first  $n$  terms of the series is  $S_n$

(e) Find the least value of  $n$  for which  $S_n$  exceeds 99% of  $S$ . (6)

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**Question 10 continued**

A series of horizontal dotted lines for writing.



**Question 10 continued**

A series of horizontal dotted lines for writing.



**Question 10 continued**

A series of horizontal dotted lines for writing.



**Question 10 continued**

Ruled writing area with horizontal dotted lines.

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**(Total for Question 10 is 17 marks)**

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**TOTAL FOR PAPER IS 100 MARKS**

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