

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

# Core Mathematics C12

## Advanced Subsidiary

Wednesday 25 May 2016 – Morning

**Time: 2 hours 30 minutes**

Paper Reference

**WMA01/01****You must have:**

Mathematical Formulae and Statistical Tables (Blue)

Total Marks

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information

- The total mark for this paper is 125.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P46713RA

©2016 Pearson Education Ltd.

1/1/1/1/1/1/1/1/



PEARSON

Leave  
blank

1. The first three terms in ascending powers of  $x$  in the binomial expansion of  $(1 + px)^8$  are given by

$$1 + 12x + qx^2$$

where  $p$  and  $q$  are constants.

Find the value of  $p$  and the value of  $q$ .

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 1 continued

Handwriting practice area with horizontal lines.

(Total 5 marks)

Q1

Mark box for Q1



P 4 6 7 1 3 R A 0 3 5 2

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave  
blank

2. Find the range of values of  $x$  for which

(a)  $4(x - 2) \leq 2x + 1$

(2)

(b)  $(2x - 3)(x + 5) > 0$

(3)

(c) **both**  $4(x - 2) \leq 2x + 1$  **and**  $(2x - 3)(x + 5) > 0$

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 2 continued

Handwriting practice area with horizontal lines.

(Total 6 marks)

Q2



P 4 6 7 1 3 R A 0 5 5 2

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

- (i) Solve the equation

(ii) (a) Express

in the form  $k\sqrt{2}$ , where  $k$  is an integer.

- (b) Hence, or otherwise, solve

$$3\sqrt{18} - \sqrt{32} = \sqrt{n} \tag{2}$$

Leave  
blank

Question 3 continued

Handwriting practice area with horizontal lines.

(Total 7 marks)

Q3



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

4.

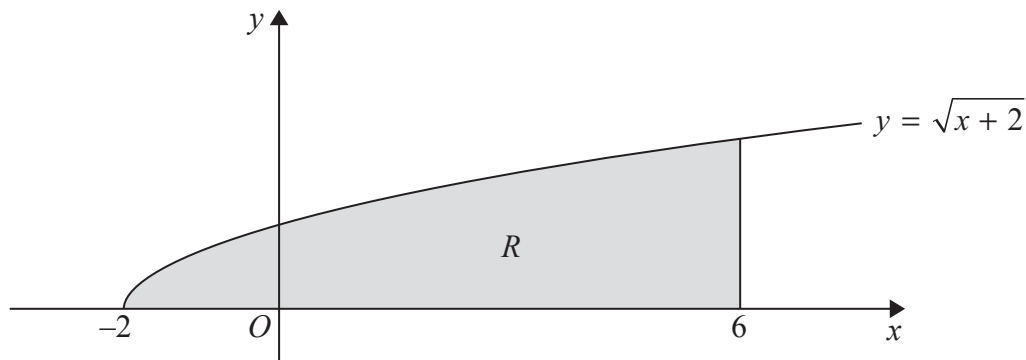


Figure 1

Figure 1 shows a sketch of part of the curve with equation  $y = \sqrt{x+2}$ ,  $x \geq -2$

The finite region  $R$ , shown shaded in Figure 1, is bounded by the curve, the  $x$ -axis and the line  $x = 6$

The table below shows corresponding values of  $x$  and  $y$  for  $y = \sqrt{x+2}$

$x$	-2	0	2	4	6
$y$	0	1.4142	2		2.8284

- (a) Complete the table above, giving the missing value of  $y$  to 4 decimal places. (1)
- (b) Use the trapezium rule, with all of the values of  $y$  in the completed table, to find an approximate value for the area of  $R$ , giving your answer to 3 decimal places. (3)

Use your answer to part (b) to find approximate values of

- (c) (i)  $\int_{-2}^6 \frac{\sqrt{x+2}}{2} dx$
- (ii)  $\int_{-2}^6 (2 + \sqrt{x+2}) dx$  (4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA





Leave  
blank

Question 4 continued

Lined area for writing the answer to Question 4 continued.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 4 continued

Handwriting practice area with horizontal lines.

(Total 8 marks)

Q4



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Leave  
blank

5. (i)

$$U_{n+1} = \frac{U_n}{U_n - 3}, \quad n \geq 1$$

Given  $U_1 = 4$ , find

(a)  $U_2$

(1)

(b)  $\sum_{n=1}^{100} U_n$

(2)

(ii) Given

$$\sum_{r=1}^n (100 - 3r) < 0$$

find the least value of the positive integer  $n$ .

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 5 continued

Handwriting practice area with horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 4 6 7 1 3 R A 0 1 3 5 2

Leave  
blank

Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 5 continued

Lined area for writing the answer to Question 5.

(Total 6 marks)

Q5

Box for marking the question.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

6. (a) Show that  $\frac{x^2 - 4}{2\sqrt{x}}$  can be written in the form  $Ax^p + Bx^q$ , where  $A$ ,  $B$ ,  $p$  and  $q$  are constants to be determined.

(3)

- (b) Hence find

$$\int \frac{x^2 - 4}{2\sqrt{x}} dx, \quad x > 0$$

giving your answer in its simplest form.

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA





Leave  
blank

Question 6 continued

Lined area for writing the answer to Question 6.

(Total 7 marks)

Q6

Box for marking the question.



Leave  
blank

7.

$$f(x) = 3x^3 + ax^2 + bx - 10, \text{ where } a \text{ and } b \text{ are constants.}$$

Given that  $(x - 2)$  is a factor of  $f(x)$ ,

(a) use the factor theorem to show that  $2a + b = -7$

(2)

Given also that when  $f(x)$  is divided by  $(x + 1)$  the remainder is  $-36$

(b) find the value of  $a$  and the value of  $b$ .

(4)

$f(x)$  can be written in the form

$$f(x) = (x - 2)Q(x), \text{ where } Q(x) \text{ is a quadratic function.}$$

(c) (i) Find  $Q(x)$ .

(ii) Prove that the equation  $f(x) = 0$  has only one real root.

You must justify your answer and show all your working.

(4)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 7 continued

Handwriting practice area with horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 7 continued

Handwriting practice area with horizontal lines.

(Total 10 marks)

Q7



**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

- (a) Show that the equation

$$\frac{5 + \sin \theta}{3 \cos \theta} = 2 \cos \theta, \quad \theta \neq (2n+1)90^\circ, \quad n \in \mathbb{Z}$$

may be rewritten as

$$6\sin^2\theta + \sin\theta - 1 = 0 \quad (3)$$

- (b) Hence solve, for  $-90^\circ < \theta < 90^\circ$ , the equation

$$\frac{5 + \sin \theta}{3 \cos \theta} = 2 \cos \theta$$

Give your answers to one decimal place, where appropriate. (4)



Leave  
blank

Question 8 continued

Handwriting practice area with horizontal lines.

(Total 7 marks)

Q8



**DO NOT WRITE IN THIS AREA**



Leave  
blank

Question 9 continued

Handwriting practice area with horizontal lines.

(Total 8 marks)

Q9



Leave  
blank

10. The curve  $C$  has equation  $y = \sin\left(x + \frac{\pi}{4}\right)$ ,  $0 \leq x \leq 2\pi$

(a) On the axes below, sketch the curve  $C$ .

(2)

(b) Write down the exact coordinates of all the points at which the curve  $C$  meets or intersects the  $x$ -axis and the  $y$ -axis.

(3)

(c) Solve, for  $0 \leq x \leq 2\pi$ , the equation

$$\sin\left(x + \frac{\pi}{4}\right) = \frac{\sqrt{3}}{2}$$

giving your answers in the form  $k\pi$ , where  $k$  is a rational number.

(4)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 10 continued

Handwriting practice area with horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**



Leave  
blank

Question 10 continued

Lined area for writing the answer to Question 10.

(Total 9 marks)

Q10



11.

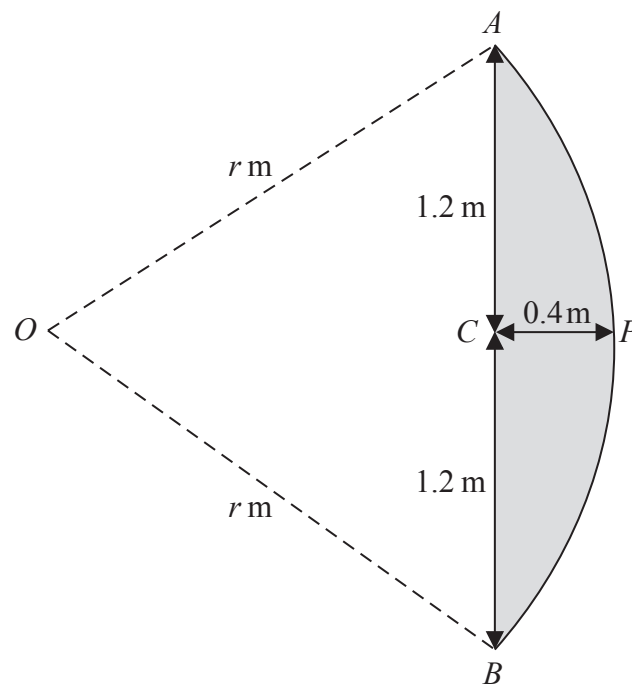


Figure 2

Figure 2 shows the design for a sail  $APBCA$ .

The curved edge  $APB$  of the sail is an arc of a circle centre  $O$  and radius  $r$  m.

The straight edge  $ACB$  is a chord of the circle.

The height  $AB$  of the sail is 2.4 m.

The maximum width  $CP$  of the sail is 0.4 m.

(a) Show that  $r = 2$  (2)

(b) Show, to 4 decimal places, that angle  $AOB = 1.2870$  radians. (2)

(c) Hence calculate the area of the sail, giving your answer, in  $\text{m}^2$ , to 3 decimal places. (4)

---

---

---

---

---

---

---

---

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 11 continued

Handwriting practice area with horizontal lines.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**





Leave  
blank

Question 11 continued

Lined area for writing the answer to Question 11.

(Total 8 marks)

Q11

Box for marking the question.

DO NOT WRITE IN THIS AREA

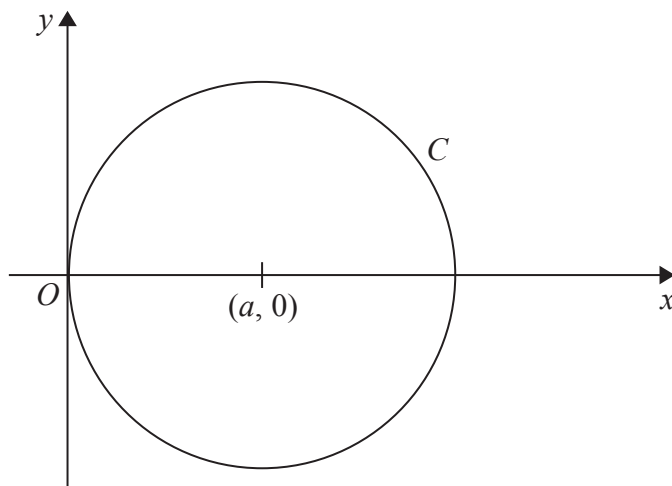
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

12.



### Figure 3

Figure 3 shows a circle  $C$

$C$  touches the  $y$ -axis and has centre at the point  $(a, 0)$  where  $a$  is a positive constant.

- (a) Write down an equation for  $C$  in terms of  $a$

(2)

Given that the point  $P(4, -3)$  lies on  $C$ ,

- (b) find the value of  $a$

(3)



Leave  
blank

Question 12 continued

Q12

(Total 5 marks)



P 4 6 7 1 3 R A 0 3 5 5 2



Leave  
blank

Question 13 continued

Lined area for writing the answer to Question 13.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**



Leave  
blank

Question 13 continued

Handwriting practice area with horizontal lines.

(Total 8 marks)

Q13



14.

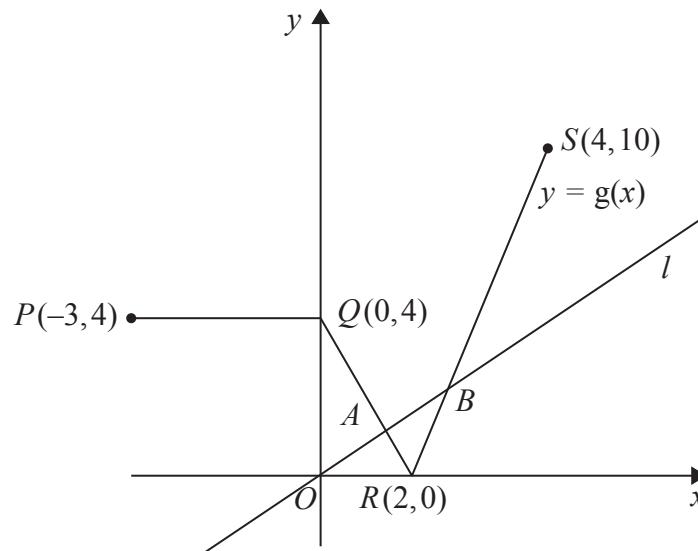


Figure 4

Figure 4 shows a sketch of the graph of  $y = g(x)$ ,  $-3 \leq x \leq 4$  and part of the line  $l$  with equation  $y = \frac{1}{2}x$

The graph of  $y = g(x)$  consists of three line segments, from  $P(-3, 4)$  to  $Q(0, 4)$ , from  $Q(0, 4)$  to  $R(2, 0)$  and from  $R(2, 0)$  to  $S(4, 10)$ .

The line  $l$  intersects  $y = g(x)$  at the points  $A$  and  $B$  as shown in Figure 4.

- (a) Use algebra to find the  $x$  coordinate of the point  $A$  and the  $x$  coordinate of the point  $B$ .

Show each step of your working and give your answers as exact fractions.

(6)

- (b) Sketch the graph with equation

$$y = \frac{3}{2}g(x), \quad -3 \leq x \leq 4$$

On your sketch show the coordinates of the points to which  $P$ ,  $Q$ ,  $R$  and  $S$  are transformed.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA





Leave  
blank

Question 14 continued

Lined area for writing the answer to Question 14.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**



Leave  
blank

Question 14 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q14

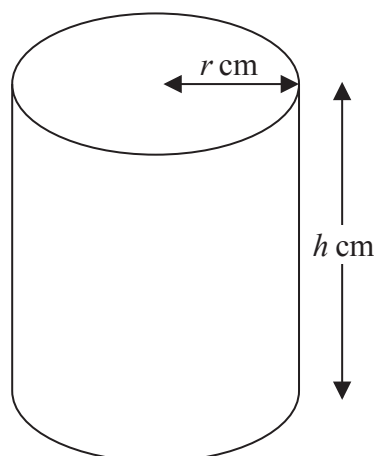
(Total 8 marks)



P 4 6 7 1 3 R A 0 4 3 5 2

Leave  
blank

15.



### Figure 5

Figure 5 shows a design for a water barrel.

It is in the shape of a right circular cylinder with height  $h$  cm and radius  $r$  cm.

The barrel has a base but has no lid, is open at the top and is made of material of negligible thickness.

The barrel is designed to hold  $60\,000\text{ cm}^3$  of water when full.

- (a) Show that the total external surface area,  $S \text{ cm}^2$ , of the barrel is given by the formula

$$S = \pi r^2 + \frac{120000}{r} \quad (3)$$

- (b) Use calculus to find the minimum value of  $S$ , giving your answer to 3 significant figures.

- (c) Justify that the value of  $S$  you found in part (b) is a minimum.



Leave  
blank

Question 15 continued

Lined area for writing the answer to Question 15.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 4 6 7 1 3 R A 0 4 5 5 2

Leave  
blank

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**

**DO NOT WRITE IN THIS AREA**



Leave  
blank

Question 15 continued

Q15

(Total 11 marks)



P 4 6 7 1 3 R A 0 4 7 5 2

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

16.

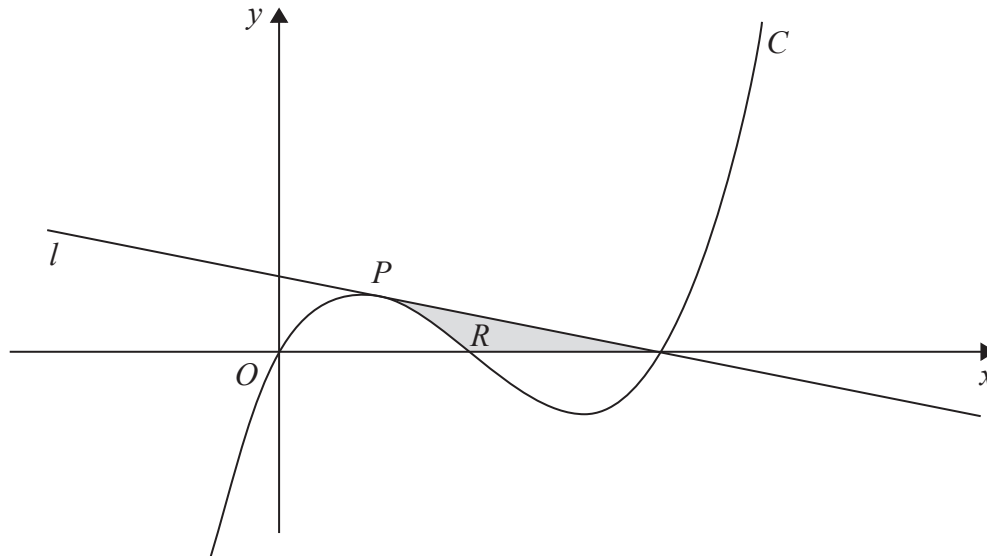


Figure 6

Figure 6 shows a sketch of part of the curve  $C$  with equation

$$y = x(x - 1)(x - 2)$$

The point  $P$  lies on  $C$  and has  $x$  coordinate  $\frac{1}{2}$

The line  $l$ , as shown on Figure 6, is the tangent to  $C$  at  $P$ .

(a) Find  $\frac{dy}{dx}$  (2)

(b) Use part (a) to find an equation for  $l$  in the form  $ax + by = c$ , where  $a$ ,  $b$  and  $c$  are integers. (4)

The finite region  $R$ , shown shaded in Figure 6, is bounded by the line  $l$ , the curve  $C$  and the  $x$ -axis.

The line  $l$  meets the curve again at the point  $(2, 0)$

(c) Use integration to find the exact area of the shaded region  $R$ . (6)

---

---

---

---

---

---

---

---

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 16 continued

Lined area for writing the answer to Question 16.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 16 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

Question 16 continued

Lined area for writing the answer to Question 16.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave  
blank

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**(Total 12 marks)**

**Q16**

**TOTAL FOR PAPER: 125 MARKS**

**END**

