Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Further Pure Mathematics

Paper 2

Monday 25 January 2016 – 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 ▶

P46241A

©2016 Pearson Education Ltd.

5/1/1/1/1/

P 4 6 2 4 1 A 0 1 3 6

PEARSON

Answer all TWELVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Find the exact solution of

$$4^{(x-2)} = 8^{(3x-1)}$$

(4)

(Total for Question 1 is 4 marks)

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

2 The sector OAB of a circle, centre O, has area $48\,\text{cm}^2$.

The length of the arc AB is $8\,\text{cm}$ and the size of angle AOB is θ radians.

Find

(i) the radius of sector OAB

(ii) the value of θ

(5)

(Total for Question 2 is 5 marks)

3 Solve the equations

$$3y = 12 - 4x$$

$$(x + 1)^2 + (y - 2)^2 = 4$$

(7)

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

Question 3 continued

(Total for Question 3 is 7 marks)

4 Given that $y = e^{2x}\sqrt{x+1}$

show that $\frac{dy}{dx} = \frac{e^{2x}(4x+5)}{2\sqrt{x+1}}$

(6)

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

Question 4 continued

(Total for Question 4 is 6 marks)

5 Given that $\alpha + \beta = 5$ and $\alpha^2 + \beta^2 = 19$

(a) show that $\alpha\beta = 3$

(2)

(b) Hence form a quadratic equation, with integer coefficients, which has roots α and β

(2)

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

(5)

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

Question 5 continued

(Total for Question 5 is 9 marks)

6

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\frac{\sin A}{\cos A} = \tan A$$

Using the above formulae, show that

(a) $\sin 2x = 2 \sin x \cos x$

(1)

(b) $\cos 2x = \cos^2 x - \sin^2 x$

(1)

(c) $\dfrac{\sin 2x}{1 + \cos 2x} = \tan x$

(4)

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

Question 6 continued

(Total for Question 6 is 6 marks)

7

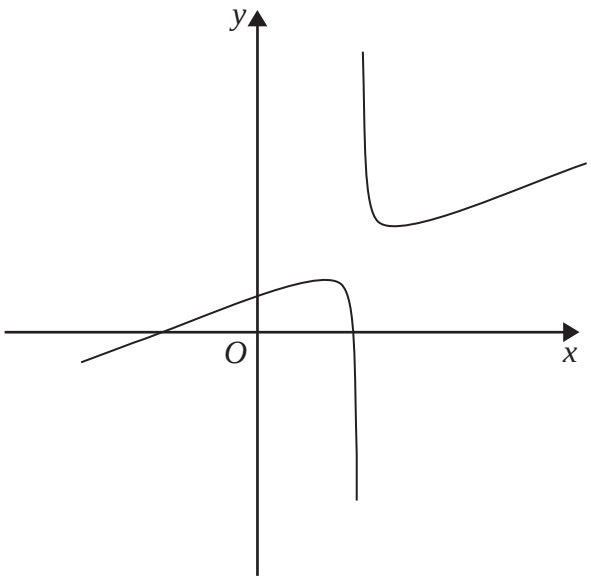


Figure 1

Figure 1 shows the curve with equation $y = \dfrac{x^2 - 2}{2x - 3}$ where $x \neq \dfrac{3}{2}$

(a) Write down an equation of the asymptote to the curve which is parallel to the y-axis.

(1)

(b) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

(3)

(c) Find the coordinates of the stationary points on the curve.

(5)

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

Question 7 continued

Question 7 continued

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

Question 7 continued

(Total for Question 7 is 9 marks)

8 The nth term of an arithmetic series is t_n where $t_n = 2n - 3$

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

(a) Show that $S_n = n(n - 2)$

(4)

(b) Find the value of n such that $5t_{n+2} = 3S_{n-3}$

(5)

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

Question 8 continued

Question 8 continued

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

Question 8 continued

(Total for Question 8 is 9 marks)

9

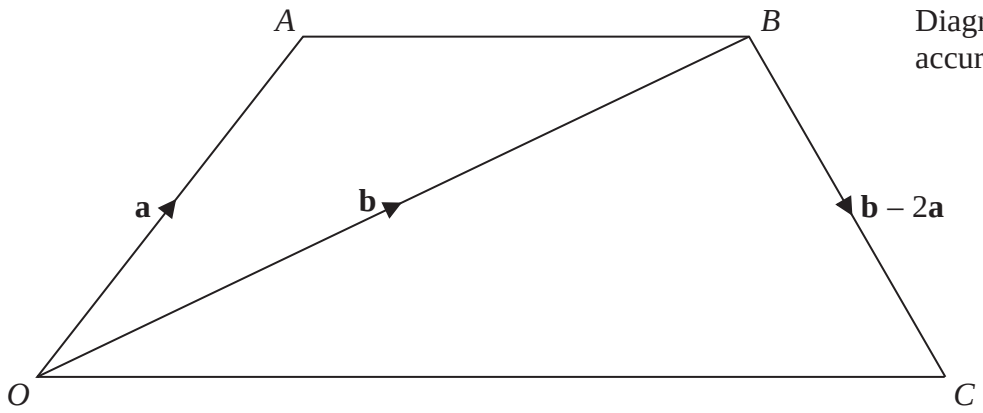


Diagram **NOT** accurately drawn

Figure 2

Figure 2 shows a quadrilateral $OABC$

$$\overrightarrow{OA} = \mathbf{a},\ \overrightarrow{OB} = \mathbf{b} \text{ and } \overrightarrow{BC} = \mathbf{b} - 2\mathbf{a}$$

(a) (i) Prove that $\overrightarrow{AB}$ is parallel to $\overrightarrow{OC}$

(ii) Show that $AB : OC = 1 : 2$

(4)

The point D lies on OB such that $OD : DB = 2 : 3$

(b) Find the ratio of the area of $\triangle ODC$: the area of $\triangle OAB$.

(6)

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

Question 9 continued

Question 9 continued

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

Question 9 continued

(Total for Question 9 is 10 marks)

10 $f(x) = 2x^3 - px^2 - 13x - q$

When $f(x)$ is divided by $(x - 2)$ the remainder is -20

Given that $(x - 3)$ is a factor of $f(x)$

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

(7)

(b) Hence use algebra to solve the equation $f(x) = 0$

(5)

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

Question 10 continued

Question 10 continued

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

Question 10 continued

(Total for Question 10 is 12 marks)

11 (a) Complete the table of values for $y = e^{(x-1)} + 2$

Give your answers to 2 decimal places where appropriate.

x	–2	–1	0	1	2	3
$f(x)$	2.05				4.72	9.39

(2)

(b) On the grid opposite, draw the graph of $y = e^{(x-1)} + 2$ for $-2 \leqslant x \leqslant 3$

(2)

(c) Use your graph to obtain an estimate, to 1 decimal place, of the root of the equation $4 = e^{(x-1)}$ in the interval $-2 \leqslant x \leqslant 3$

(2)

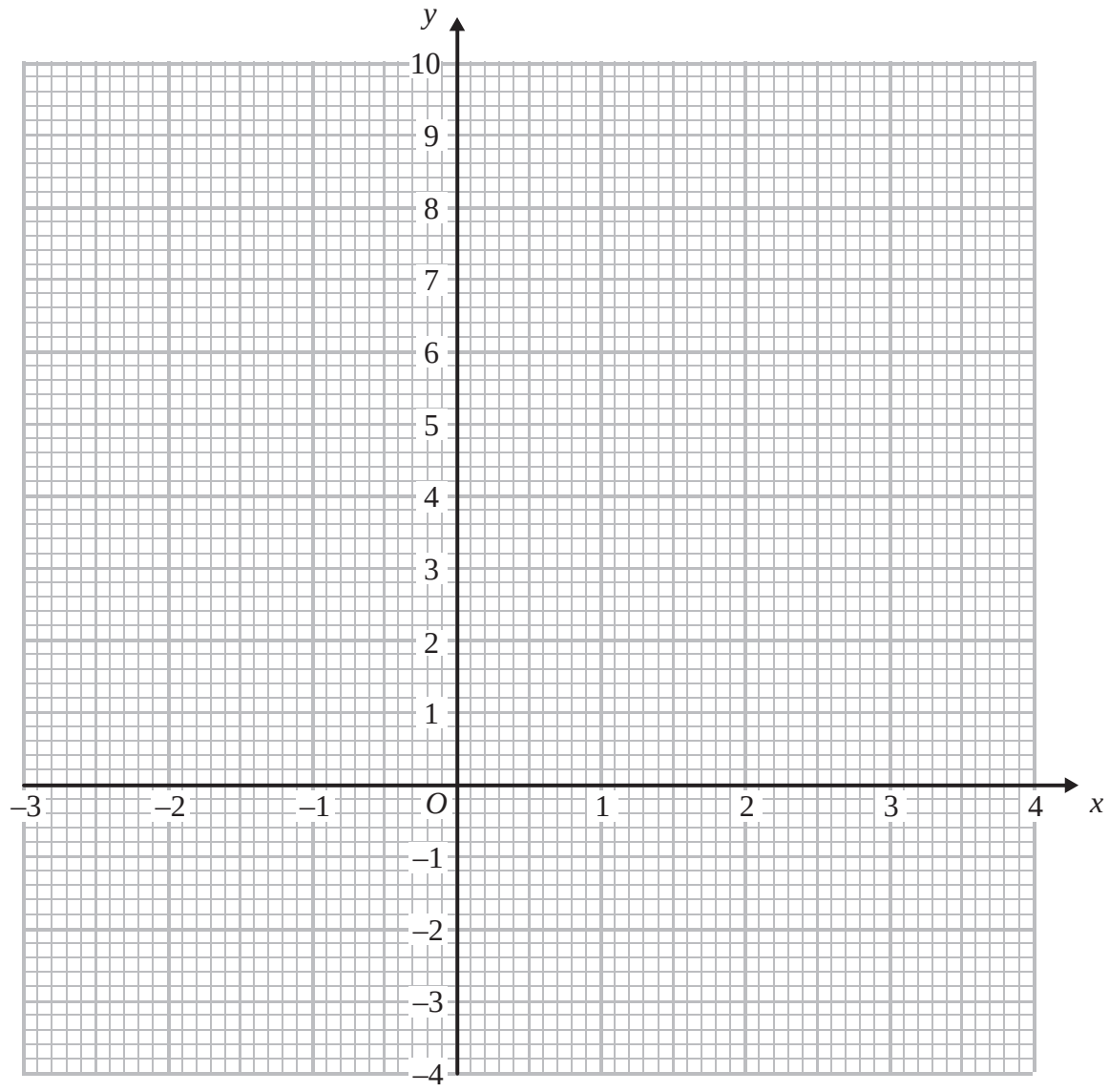
(d) By drawing a straight line on the grid, obtain an estimate, to 1 decimal place, of the root of the equation $\ln(4x - 4) = x - 1$ in the interval $-2 \leqslant x \leqslant 3$

(5)

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

Question 11 continued



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

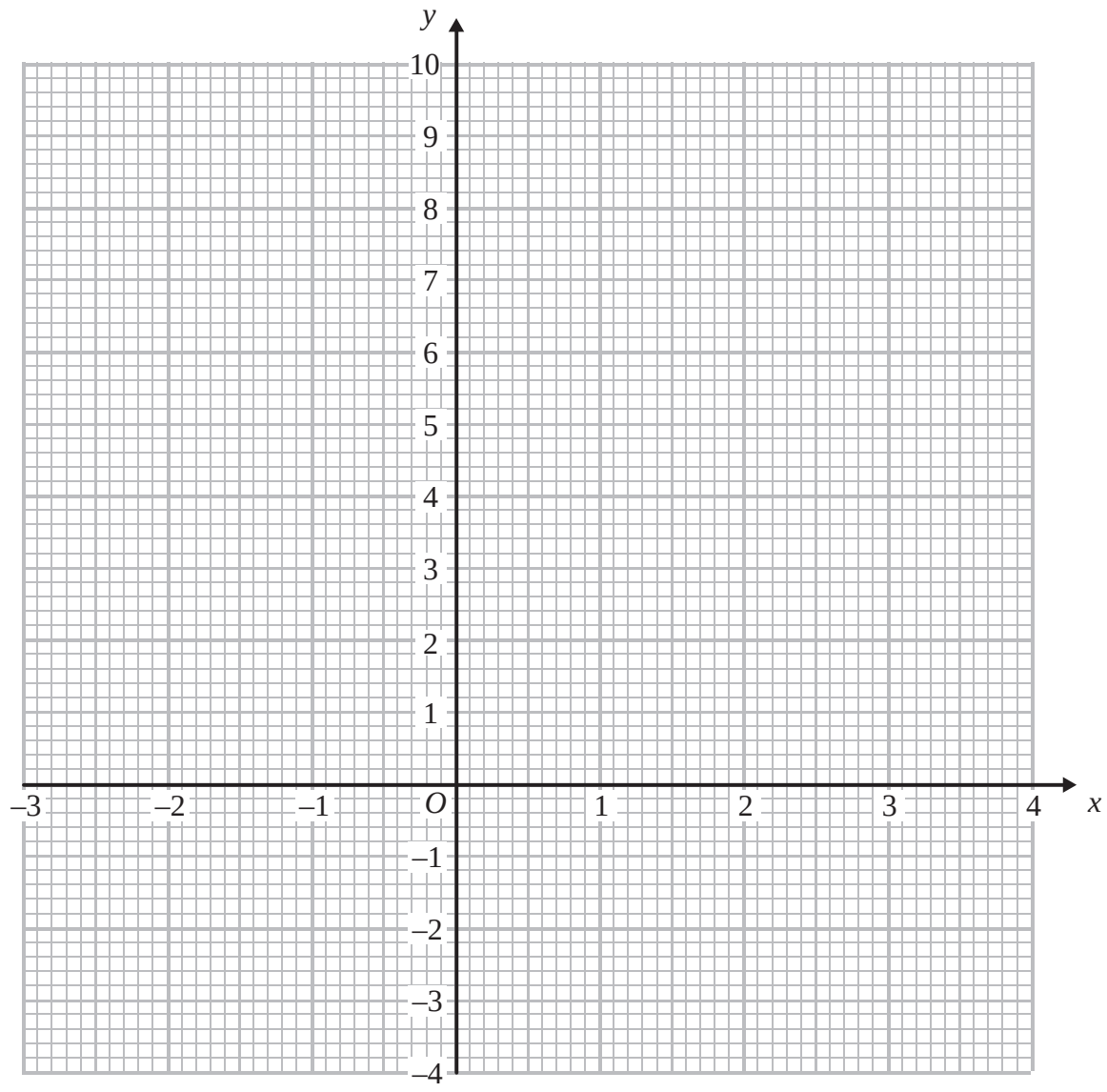
Question 11 continued

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

Question 11 continued

Only use this grid if you need to redraw your graph.



(Total for Question 11 is 11 marks)

12

Diagram **NOT** accurately drawn

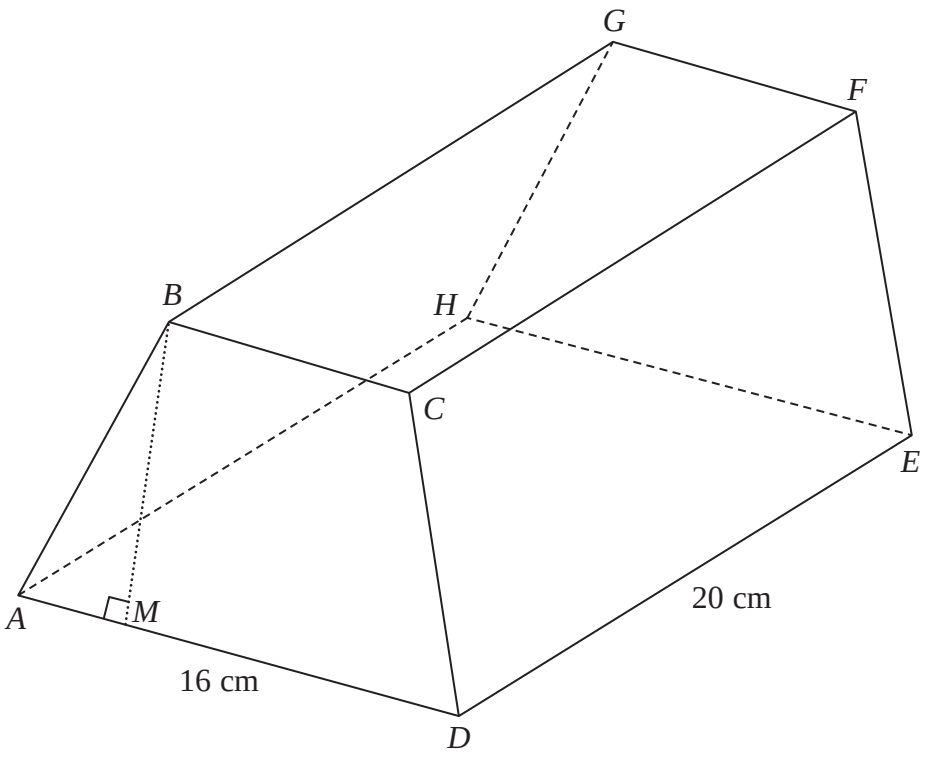


Figure 3

Figure 3 shows a right prism *ABCDEFGH*. The cross section *ABCD* of the prism is a trapezium with *AB* = *DC*. The point *M* lies on *AD* and *BM* is perpendicular to *AD*.

AB = 8 cm *CD* = 8 cm *BC* = 8 cm *AD* = 16 cm *DE* = 20 cm

Given that $BM = p\sqrt{q}$ cm where *q* is a prime number,

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

(3)

(b) Find the size of angle *BAM* in degrees.

(2)

Find, in degrees to the nearest 0.1°

(c) the size of the angle between *EB* and the plane *ADEH*,

(4)

(d) the size of the angle between the plane *BCEH* and the plane *ADEH*.

(3)

.....

.....

.....

.....

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

Question 12 continued

Question 12 continued

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

Question 12 continued

Question 12 continued

(Total for Question 12 is 12 marks)

TOTAL FOR PAPER IS 100 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA