Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Further Pure Mathematics

Paper 2

Monday 23 January 2017 – 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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Pearson

Answer all TEN questions.

Write your answers in the spaces provided.

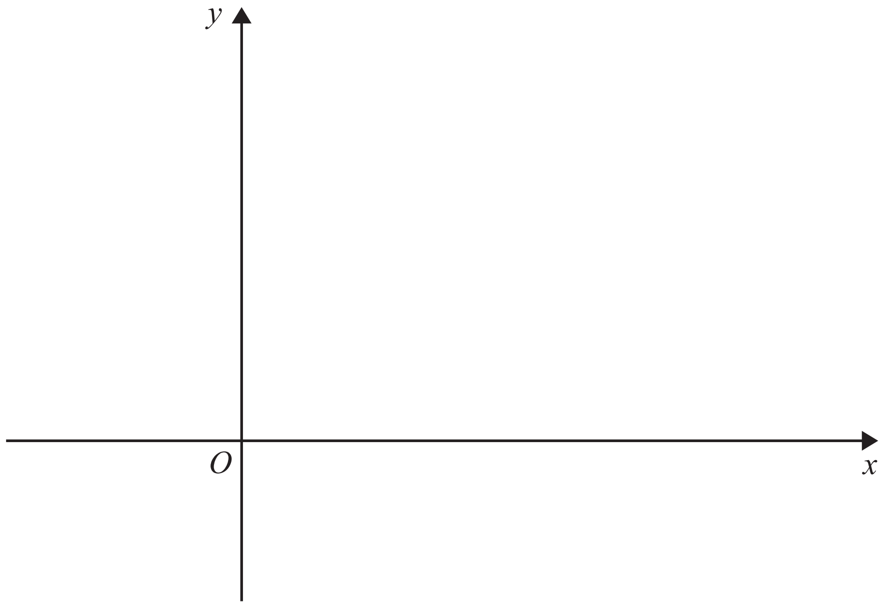
You must write down all the stages in your working.

1 (a) On the axes below, sketch the lines with equations $x = 3$, $y = x + 1$ and $2y + x = 5$
On your sketch, mark the coordinates of any points where the lines cross the axes.
(3)

(b) Show, by shading on your sketch, the region R defined by the inequalities

$$x \leqslant 3, \ y \leqslant x + 1 \ \text{and} \ 2y + x \geqslant 5$$

(1)



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Question 1 continued

(Total for Question 1 is 4 marks)

2 (a) Show that the equation $6\cos^2\alpha - \sin\alpha = 5$ can be written as

$$6\sin^2\alpha + \sin\alpha - 1 = 0$$

(2)

(b) Solve, to 1 decimal place where appropriate, for $0 \leqslant \theta \leqslant 90$

$$6\cos^2(2\theta + 40)° - \sin(2\theta + 40)° = 5$$

(5)

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Question 2 continued

(Total for Question 2 is 7 marks)

3 The radius of a circular pool of oil is increasing at a constant rate of 0.5 cm/s.

Find, in cm^2/s to 3 significant figures, the rate at which the area of the pool is increasing when the radius of the pool is 200 cm.

(5)

Question 3 continued

(Total for Question 3 is 5 marks)

4

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

(a) (i) Write down an expression for $\tan(2x)$ in terms of $\tan x$

(ii) Hence show that $\tan(3x) = \dfrac{3\tan x - \tan^3 x}{1 - 3\tan^2 x}$

(6)

Given that α is the acute angle such that $\cos\alpha = \dfrac{1}{3}$

(b) find the exact value of $\tan\alpha$

(2)

(c) Hence use the identity in part (a) to find the exact value of $\tan(3\alpha)$

Give your answer in the form $\dfrac{a\sqrt{2}}{b}$ where a and b are integers.

(2)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 10 marks)

5 Given that $y = 3x\sqrt{2x-1} \qquad x > \frac{1}{2}$

(a) show that $\frac{dy}{dx} = \frac{3(3x-1)}{\sqrt{2x-1}}$

(5)

The straight line l is the normal to the curve with equation $y = 3x\sqrt{2x-1}$ at the point on the curve where $x = 1$

(b) Find an equation, with integer coefficients, for l.

(6)

Question 5 continued

Question 5 continued

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Question 5 continued

(Total for Question 5 is 11 marks)

6 The sum of the first 21 terms of an arithmetic series is 987 and the 8th term of the series is 35

The first term of the series is a and the common difference is d.

(a) Find the value of

(i) a,

(ii) d.

(5)

The sum, S_n, of the first n terms of the series is given by $S_n = \sum_{r=1}^{n}(Ar + B)$, where A and B are integers.

(b) Find the value of

(i) A,

(ii) B.

(3)

(c) Find the least value of n such that $S_n > 2000$

(5)

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Question 6 continued

P 4 8 4 0 8 A 0 1 7 3 6

Question 6 continued

Question 6 continued

(Total for Question 6 is 13 marks)

7 (a) Given that k is a constant such that $\dfrac{27^{(x+2)} - 3^{(3x+5)}}{3^x \times 9^{(x+2)}} = k$

find the value of k.

(5)

(b) Find the exact roots of the equation $2\log_2 y + 3\log_y 2 = 7$

(6)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 11 marks)

8 [In this question, **p** and **q** are non-zero and non-parallel vectors.]

O, A, B and C are fixed points such that

$$\overrightarrow{OA} = 5\mathbf{p} - 3\mathbf{q} \qquad \overrightarrow{OB} = 11\mathbf{p} \qquad \overrightarrow{OC} = 13\mathbf{p} + \mathbf{q}$$

(a) (i) Show that the points A, B and C are collinear.

(ii) Write down the ratio $AB:BC$.

(4)

The midpoint of OA is M and the midpoint of OB is N.

(b) Show that the ratio of the area of the quadrilateral $ABNM$ to the area of the triangle OAC is $9:16$

(7)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 11 marks)

9 The points P and Q have coordinates $(-2, 5)$ and $(2, -3)$ respectively.

(a) Find an equation for the line PQ.

(2)

The point N is such that PNQ is a straight line and $PN:NQ = 3:1$

The straight line l passes through N and is perpendicular to PQ.

(b) Find

(i) the coordinates of N,

(ii) an equation for l.

(5)

The points S and T lie on l and have coordinates $(3, s)$ and $(t, -2)$ respectively.

(c) Find

(i) the value of s,

(ii) the value of t.

(2)

(d) Find the area of the quadrilateral $PSQT$.

(4)

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Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 13 marks)

10

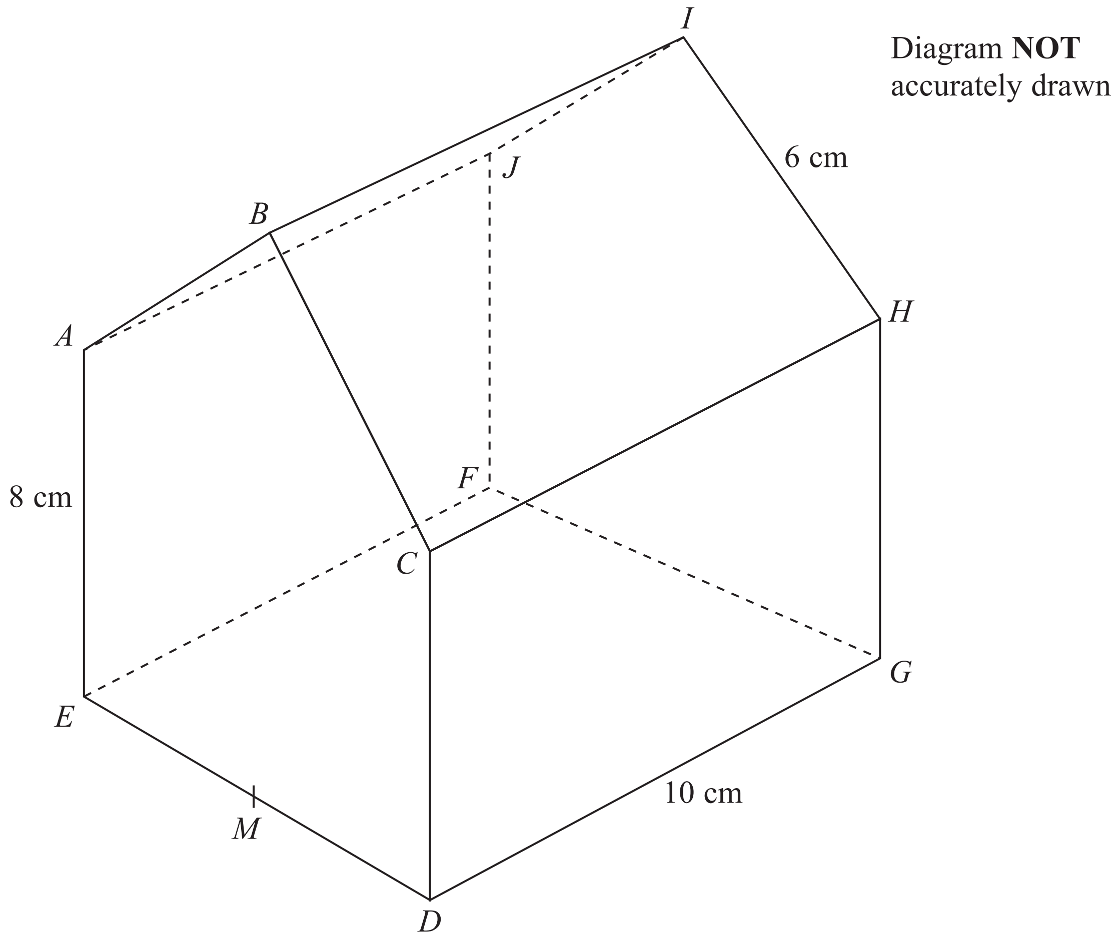

Figure 1

Figure 1 shows a right prism *ABCDEFGHIJ*. The base, *DEFG*, is horizontal and is a rectangle with $DG = EF = 10$ cm. The midpoint of *ED* is *M*.

The planes *ABCDE* and *JIHGF* are vertical.
$AE = CD = GH = FJ = 8$ cm
$AB = BC = HI = IJ = 6$ cm
Angle $BAC = 30°$

(a) Show that the length of *MD* is $3\sqrt{3}$ cm.
(2)

(b) Show that the length of *BM*, the height of the prism, is 11 cm.
(2)

(c) Find, in cm to 3 significant figures, the length *BG*.
(3)

Find, in degrees to 1 decimal place

(d) the size of the angle between the planes *BCHI* and *CHFE*,
(3)

(e) the size of the angle between the planes *ABIJ* and *BEFI*.
(5)

Question 10 continued

Question 10 continued

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Question 10 continued

Question 10 continued

(Total for Question 10 is 15 marks)

TOTAL FOR PAPER IS 100 MARKS