Write your name here

| Surname | Other names |
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**Edexcel**
**International GCSE**

Centre Number | | | | | |

Candidate Number | | | | |

# Further Pure Mathematics

## Paper 2

Thursday 26 January 2012 – Afternoon
**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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6/6/6/6/c2

P 4 0 6 6 5 A 0 1 3 2

PEARSON

**Answer all TEN questions**
**Write your answers in the spaces provided**
**You must write down all stages in your working**

**1** Referred to a fixed origin $O$, the position vectors of the points $P$ and $Q$ are $(10\mathbf{i} - 3\mathbf{j})$ and $(4\mathbf{i} + 6\mathbf{j})$ respectively. The point $R$ divides $PQ$ internally in the ratio 2:1

(a) Find the position vector of $R$

**(2)**

The point $S$ divides $OQ$ internally in the ratio $5:4$ and area $\triangle OPQ = \lambda$ area $\triangle SRQ$.

(b) Find the exact value of $\lambda$.

**(4)**

**Question 1 continued**

**(Total for Question 1 is 6 marks)**

**2**

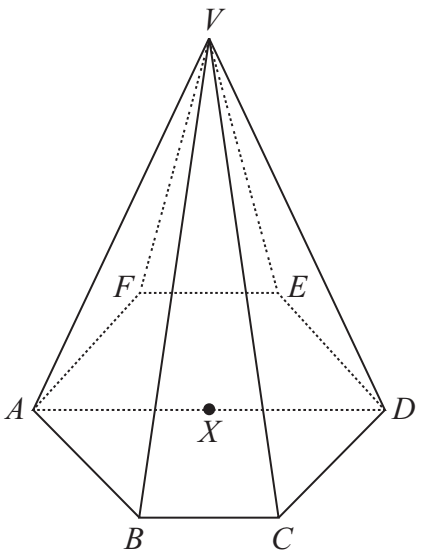


Diagram **NOT** accurately drawn

**Figure 1**

Figure 1 shows a right pyramid with vertex $V$ and base $ABCDEF$ which is a regular hexagon. The diagonal $AD$ of the base is 10 cm and $X$ is the mid-point of $AD$. The height $VX$ of the pyramid is 12 cm.

(a) Find the length of $VA$.

**(2)**

(b) Find, in degrees to 1 decimal place, the size of the angle between the plane $VAB$ and the base.

**(4)**

**Question 2 continued**

**Question 2 continued**

**(Total for Question 2 is 6 marks)**

**3** Find the coordinates of the points of intersection of the curve with equation $y = 3 + 6x - x^2$ and the line with equation $y - x = 7$

**(5)**

**(Total for Question 3 is 5 marks)**

**4**

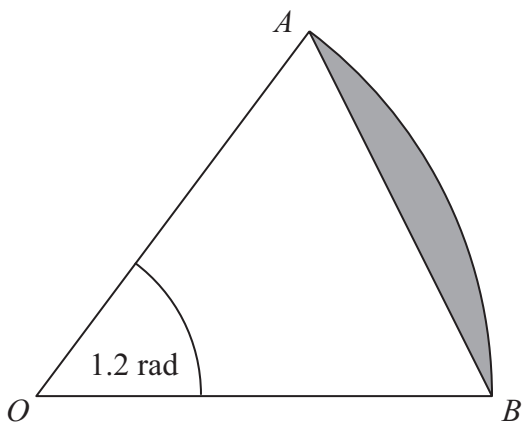


Diagram **NOT** accurately drawn

**Figure 2**

Figure 2 shows an arc $AB$ of a circle with centre $O$. The arc subtends an angle of 1.2 radians at $O$ and the area of the sector $AOB$ is 15 cm$^2$.

Find

(a) the radius of the circle,

**(2)**

(b) the length of the arc $AB$,

**(2)**

(c) the area of the shaded segment, giving your answer to 3 significant figures.

**(3)**

**Question 4 continued**

**(Total for Question 4 is 7 marks)**

**5** (a) Expand $(1+3x)^{\frac{1}{5}}$ in ascending powers of $x$ up to and including the term in $x^3$, simplifying your terms as far as possible.

**(4)**

(b) By substituting $x = -\frac{1}{8}$ into your expansion, obtain an approximation for $\sqrt[5]{20}$

Write down all the figures on your calculator display.

**(4)**

(c) Explain why you cannot obtain an approximation for $\sqrt[5]{4}$ by substituting $x = 1$ into your expansion.

**(1)**

**Question 5 continued**

**Question 5 continued**

**Question 5 continued**

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

**6**

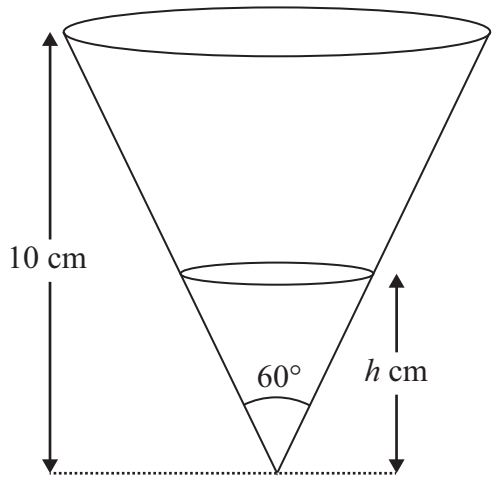


Diagram **NOT** accurately drawn

**Figure 3**

A container in the shape of a right circular cone of height 10 cm is fixed with its axis of symmetry vertical. The vertical angle of the container is 60°, as shown in Figure 3. Water is dripping out of the container at a constant rate of 2 $cm^3/s$. At time $t = 0$ the container is full of water. At time $t$ seconds the depth of water remaining is $h$ cm.

(a) Show that $h = \left[1000 - \frac{18t}{\pi}\right]^{\frac{1}{3}}$

**(6)**

(b) Find, in $cm^2/s$, to 3 significant figures, the rate of change of the area of the surface of the water when $t = 15$

**(6)**

**Question 6 continued**

**Question 6 continued**

**Question 6 continued**

**(Total for Question 6 is 12 marks)**

**7** The points $A$, $B$ and $C$ have coordinates (3,5), (7,8) and (6,1) respectively.

(a) Show, by calculation, that $AB$ is perpendicular to $AC$.

**(4)**

(b) Find an equation for $AC$ in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers whose values must be stated.

**(3)**

The point $D$ is on $AC$ produced and $AC : CD = 1 : 2$

(c) Find the coordinates of $D$.

**(2)**

(d) Calculate the area of triangle $ABD$.

**(4)**

**Question 7 continued**

**Question 7 continued**

**Question 7 continued**

**(Total for Question 7 is 13 marks)**

**8**

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

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

(a) Show that $\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B}$

**(3)**

(b) Hence write down an expression for $\tan 2\theta$ in terms of $\tan\theta$

**(1)**

(c) Show that $\tan 3\theta = \dfrac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}$

**(4)**

Given that $\tan 3\theta = -1$ and $\tan\theta \neq \pm\dfrac{\sqrt{3}}{3}$

(d) without finding the value of $\theta$, show that $\tan^3\theta + 3\tan^2\theta - 3\tan\theta - 1 = 0$

**(1)**

Given also that $\tan\theta \neq 1$

(e) find the exact values of $\tan\theta$, giving your answers in the form $a \pm \sqrt{b}$ where $a$ and $b$ are integers.

**(4)**

**Question 8 continued**

**Question 8 continued**

**Question 8 continued**

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

**9** The curve $C$, with equation $y = f(x)$, passes through the point with coordinates $(0, 4)$.

Given that $f'(x) = x^3 - 3x^2 - x + 3$

(a) find $f(x)$.

**(3)**

(b) Show that $C$ has a minimum point at $x = -1$ and a minimum point at $x = 3$

**(6)**

(c) (i) Find the coordinates of the maximum point on $C$.

(ii) Show that the point found in (i) is a maximum point.

**(3)**

(d) State the ranges of values of $x$ for which $f'(x) > 0$

**(2)**

**Question 9 continued**

**Question 9 continued**

**Question 9 continued**

**(Total for Question 9 is 14 marks)**

**10** The sum of the first and third terms of a geometric series $G$ is 104

The sum of the second and third terms of $G$ is 24

Given that $G$ is convergent and that the sum to infinity is $S$, find

(a) the common ratio of $G$

**(4)**

(b) the value of $S$

**(4)**

The sum of the first and third terms of another geometric series $H$ is also 104 and the sum of the second and third terms of $H$ is 24
The sum of the first $n$ terms of $H$ is $S_n$

(c) Write down the common ratio of $H$

**(1)**

(d) Find the least value of $n$ for which $S_n > S$

**(6)**

**Question 10 continued**

**Question 10 continued**

**(Total for Question 10 is 15 marks)**

**TOTAL FOR PAPER IS 100 MARKS**