Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Tuesday 20 May 2025

Afternoon (Time: 2 hours)

Paper reference **4PM1/01R**

Further Pure Mathematics
PAPER 1R

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.*
- You must **NOT** write anything on the formulae page.
  Anything you write on the formulae page will gain NO credit.

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 7 6 5 0 7 A 0 1 3 2

Pearson

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

Surface area of sphere = $4\pi r^2$

Curved surface area of cone = $\pi r \times$ slant height

Volume of sphere = $\frac{4}{3}\pi r^3$

Series

Arithmetic series

Sum to n terms, $S_n = \frac{n}{2}[2a + (n-1)d]$

Geometric series

Sum to n terms, $S_n = \frac{a(1-r^n)}{(1-r)}$

Sum to infinity, $S_\infty = \frac{a}{1-r} \quad |r| < 1$

Binomial series

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots \quad \text{for} \quad |x| < 1, n \in \mathbb{Q}$$

Calculus

Quotient rule (differentiation)

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{\mathrm{f}(x)}{\mathrm{g}(x)}\right) = \frac{\mathrm{f}'(x)\mathrm{g}(x) - \mathrm{f}(x)\mathrm{g}'(x)}{[\mathrm{g}(x)]^2}$$

Trigonometry

Cosine rule

In triangle ABC: $a^2 = b^2 + c^2 - 2bc\cos A$

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

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

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

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

Logarithms

$\log_a x = \frac{\log_b x}{\log_b a}$

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 $\left(8-\sqrt{6}\right)w=50$

Without using a calculator, find the value of w

Give your answer in the form $\frac{a+b\sqrt{6}}{c}$ where a and b are integers and c is prime.

Show your working clearly.

(3)

(Total for Question 1 is 3 marks)

2 An arithmetic series F has third term 8 and fifth term 20

Given that the sum to n terms of F is greater than 220

find the least value of n

(7)

Question 2 continued

(Total for Question 2 is 7 marks)

3 A particle P is moving along a straight line, from a fixed origin O

At time t seconds $(t \geqslant 0)$, the velocity, v m/s, of P is given by

$$v = 2t^2 - 19t + 35$$

At time t seconds the acceleration of P is a m/s^2

(a) Find the value of t for which $a = 0$

(3)

P is instantaneously at rest at time T_1 seconds and at time T_2 seconds where $T_2 > T_1$

(b) Find the value of T_1 and the value of T_2

(3)

(c) Find the exact distance, in metres, that P travels between the times T_1 and T_2
Show your working clearly.

(4)

Question 3 continued

(Total for Question 3 is 10 marks)

4 Triangle ABC is such that

$AB = 4.3$ cm $\quad$ $BC = 5.9$ cm $\quad$ angle $BCA = 29°$

(a) Find in degrees, to one decimal place, the two possible values for angle CAB

(4)

(b) Hence, find in cm, to 3 significant figures, the shortest possible length of AC

(3)

Question 4 continued

(Total for Question 4 is 7 marks)

5

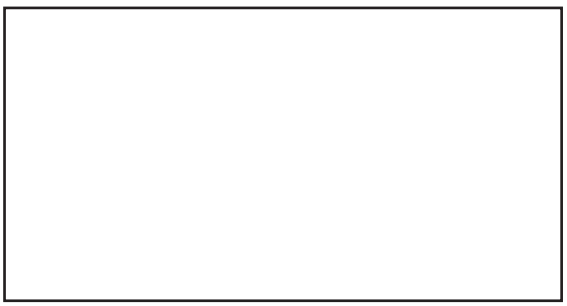

Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows a rectangle with width x cm and length $(2x+3)$ cm.

The perimeter of the rectangle is P cm and the area of the rectangle is A cm^2

$$P > 10 \quad \text{and} \quad A < 35$$

Find the set of possible values for x
Give your answer in the form $a < x < b$ where a and b are rational numbers.
Show clear algebraic working.

(7)

Question 5 continued

(Total for Question 5 is 7 marks)

6 Referred to a fixed origin O, the position vector of the point A is $(9\mathbf{a}+12\mathbf{b})$

and the position vector of the point B is $(2\mathbf{a}+p\mathbf{b})$ where $|\mathbf{a}|=|\mathbf{b}|=1$

Given that $|AB|=25$

(a) show that the two possible values of p are -12 and 36

(4)

For $p=-12$

(b) find a unit vector parallel to $\overrightarrow{OB}$
Give your answer in terms of **a** and **b** in its simplest form.

(2)

Point C lies on OB such that $OC:CB=2:3$

For $p=36$

(c) find $\overrightarrow{CA}$
Give your answer in terms of **a** and **b** in its simplest form.

(3)

Question 6 continued

(Total for Question 6 is 9 marks)

7 (a) Complete the table of values for $y = 3\log_3\left(x^2 - x\right) - 2x$ giving your answers to 2 decimal places.

x	1.3	1.5	2	2.5	3	3.5
y		−3.79	−2.11			

(2)

(b) On the grid opposite, draw the graph of $y = 3\log_3\left(x^2 - x\right) - 2x$ for $1.3 \leqslant x \leqslant 3.5$

(2)

(c) By drawing a suitable straight line on the grid, obtain an estimate, to one decimal place, of the root of the equation

$$3^{\frac{4}{3}x} = 9\left(x^2 - x\right)^3 \quad \text{in the interval} \quad 1.3 \leqslant x \leqslant 3.5$$

(6)

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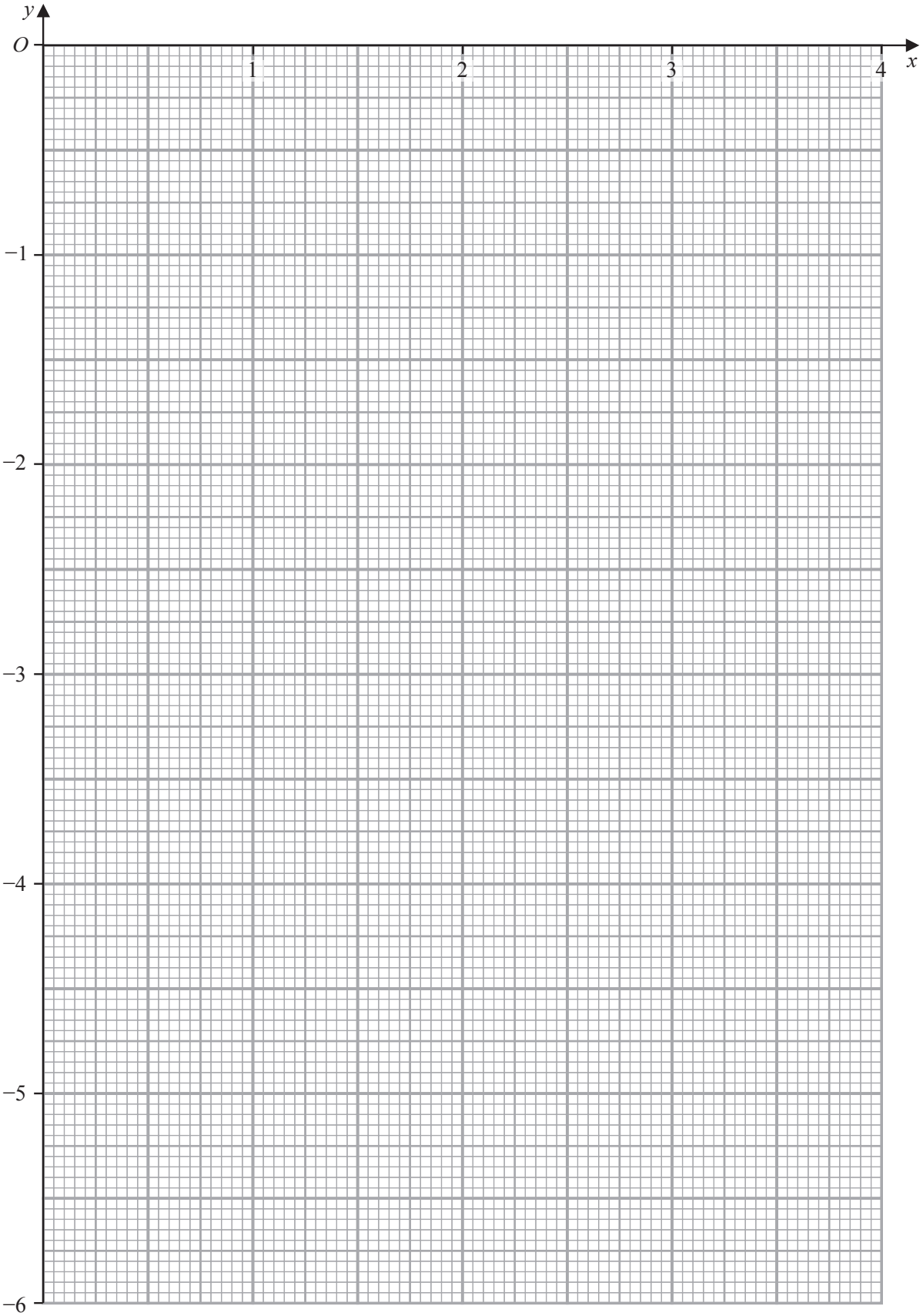
Question 7 continued

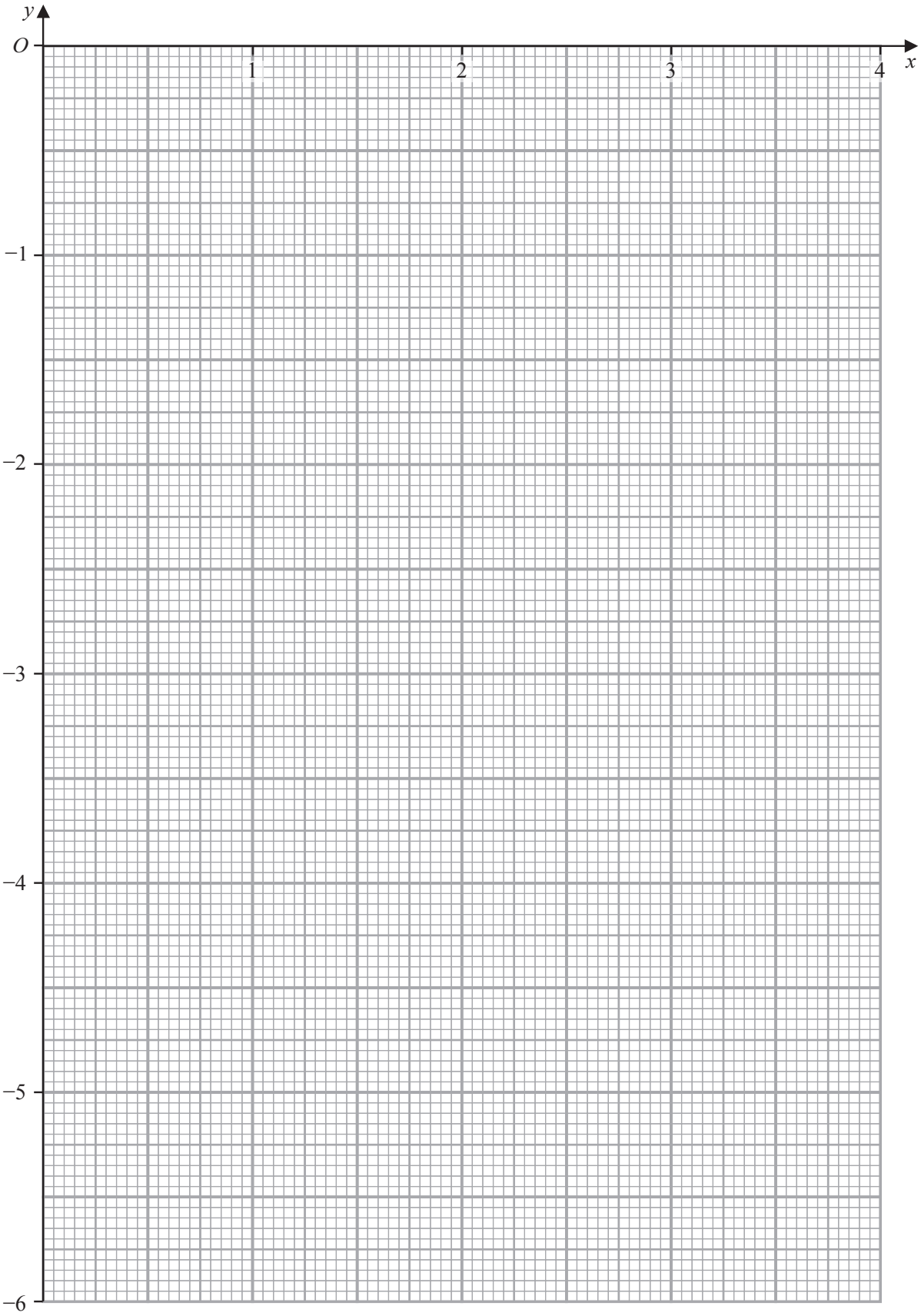


Turn over for a spare grid if you need to redraw your graph.

Question 7 continued

Question 7 continued

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



(Total for Question 7 is 10 marks)

8 $f(x) = 2x^2 - 4x + 9$

The curve C has equation $y = f(x)$
The line l with equation $y - 8x + 9 = 0$ is a tangent to C
The line k is perpendicular to l and is also the tangent to C at the point where $x = p$

(a) Find the value of p

(5)

(b) Show that

(i) $(\alpha + \beta)^3 = \alpha^3 + \beta^3 + 3\alpha\beta(\alpha + \beta)$

(ii) $\alpha^4 + \beta^4 = \left((\alpha + \beta)^2 - 2\alpha\beta\right)^2 - 2(\alpha\beta)^2$

(2)

The quadratic equation $f(x) = 0$ has roots α and β
Without solving the equation and using your results from part (b)

(c) form a quadratic equation with integer coefficients, that has roots

$\alpha^3 - \beta$ and $\beta^3 - \alpha$

(8)

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Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 15 marks)

9 Given that $f(x) = (1+x^2)^4$

(a) show that $f'(x) = 8x(1+x^2)^3$

(2)

The curve C has equation $y = \dfrac{\sin 3x}{(1+x^2)^4}$

The point A on C has x coordinate $\dfrac{2\pi}{3}$

(b) Show that the gradient of the normal to C at A is

$$-\frac{1}{3}\left(1+\left(\frac{2\pi}{3}\right)^2\right)^4$$

(7)

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Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 9 marks)

10 (a) Using a formula from page 2, show that

(i) $\sin^2 A = \dfrac{1-\cos 2A}{2}$

(ii) $\cos^2 A = \dfrac{\cos 2A+1}{2}$

(5)

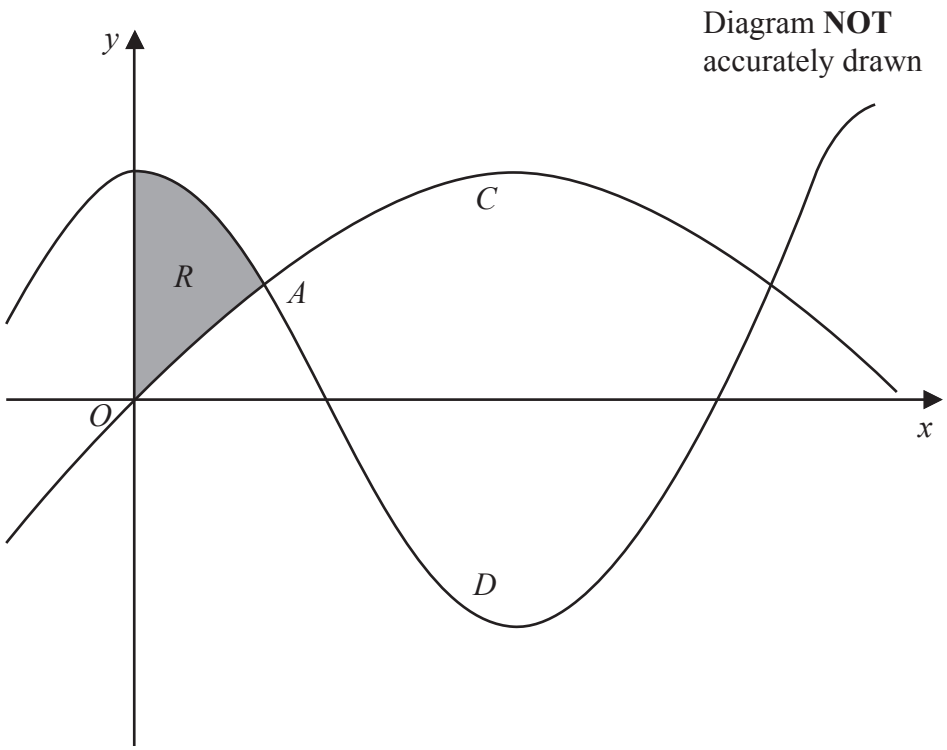

Figure 2

Figure 2 shows part of the curve C with equation $y = \sin x$ and part of the curve D with equation $y = \cos 2x$
Curve C and curve D intersect at the point A

(b) Use algebra to find the exact coordinates of A

(5)

The shaded region R is rotated through $360°$ about the x-axis.

(c) Use algebraic integration to find the exact volume of the solid generated.

Give your answer in the form $\dfrac{a\sqrt{a}}{b}\pi$

where a is a prime number and b is an integer.

(5)

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 15 marks)

11

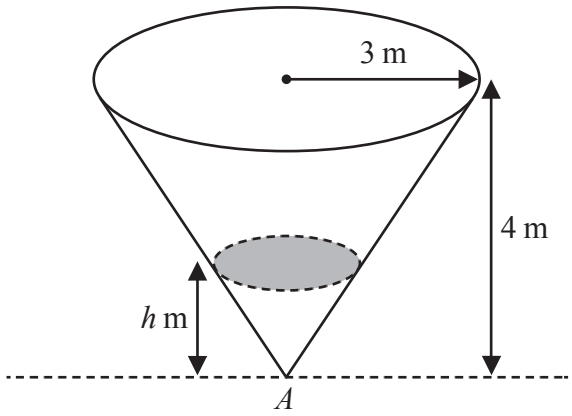

Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows a hollow right circular cone with radius 3 metres and height 4 metres above the vertex A

The cone is fixed with its axis of symmetry vertical.
The cone is initially empty.

Water pours into the cone at a constant rate of 9π m^3/s
At time t seconds after the water starts to pour into the cone, the height of the water is h metres above A

Find, in m/s, the rate at which the height of the water is increasing at the instant when $h = 2$

(8)

Question 11 continued

Question 11 continued

(Total for Question 11 is 8 marks)

TOTAL FOR PAPER IS 100 MARKS