

Practice Paper 1(Pure- Y13)

Total: 100 marks

Name: _____



**MATHSFLEX
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Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name.
- 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 14 questions in this question paper. The total mark 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Question	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
TOTAL	

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Q2

$$f(x) = 3x^3 - 2ax^2 - 28x - 8a$$

Given that $(x + 2)$ is a factor of $f(x)$, find the value of the constant a .

(3 marks)

[illegible]

Q3

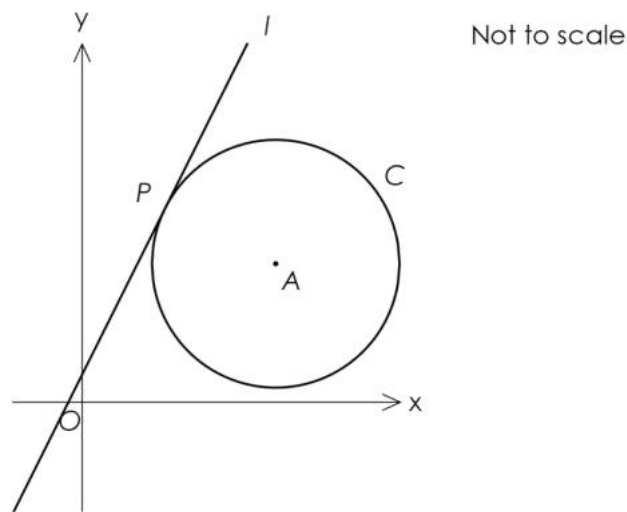


Figure 1

The circle C has centre $(6, 4)$

The line l , with equation $y = 3x + 1$, is the tangent to C at the point P , as shown in Figure 2.

- a. Show that the equation for the line PA is $3y + x = 18$ (3 marks)
- b. Find an equation for C (4 marks)

The line with equation $y = 3x + k$, $k \neq 1$ is also a tangent to C .

- c. Find the value of the constant k . **(3 marks)**

[illegible]

Q5

A competitor is running a 30 kilometre race.

She runs each of the first 6 kilometres at a steady pace of 8 minutes per kilometre.

After the first 6 kilometres she begins to slow down.

In order to estimate her finishing time, the time she takes to complete each subsequent kilometre is modelled to be 3% greater than the time she took to complete the previous kilometre.

Using the model,

- a. show that her time to run the first 8 kilometres is estimated to be 64 minutes and 44 seconds. **(2 marks)**
- b. show that her estimated time, in minutes, to run the r th kilometre, for $7 \leq r \leq 30$, is

$$8 \times 1.03^{r-6}$$

(1 mark)

- c. estimate the total time, in minutes and seconds, that she will take to complete the race.

(4 marks)

[illegible]

Q6

- a. “If m and n are irrational numbers, where $m \neq n$, then mn is also irrational.”

Disprove this statement by means of a counter example.

(2 marks)

- b. i. Sketch the graph of $y = |x| + 5$

- ii. Explain why $|x| + 5 \geq |x + 5|$ for all real values of x .

(3 marks)

[illegible]

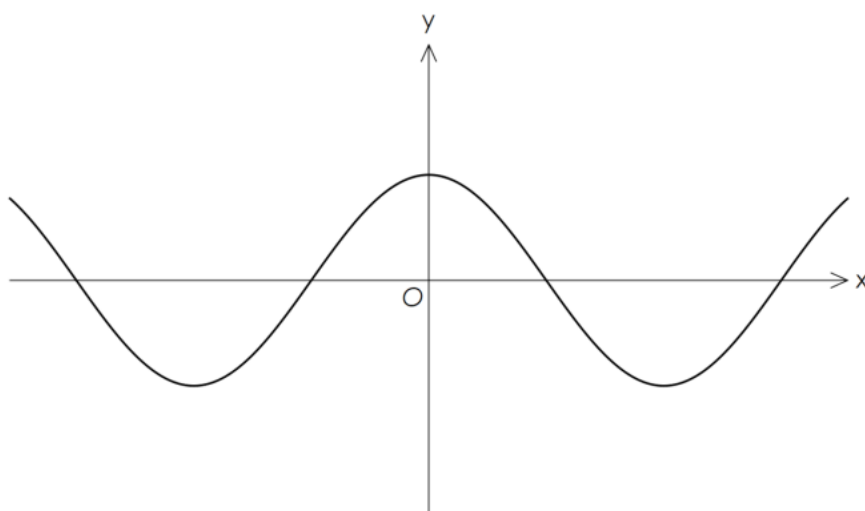
Q9**Figure 2**

Figure 2 shows a plot of part of the curve with equation $y = \cos x$ where x is measured in radians.

- a. Use Figure 2 to show why the equation

$$\cos x - 4x - \frac{3}{4} = 0$$

has only one real root, giving a reason for your answer.

(2 marks)

Given that the root of the equation is α , and that α is small,

- b. use the small angle approximation for $\cos x$ to estimate the value of α to 3 decimal places.

(3 marks)

Q11

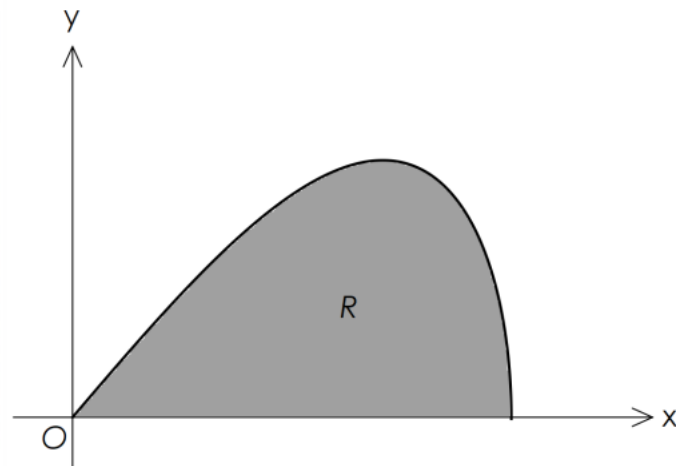


Figure 3

The curve shown in Figure 3 has parametric equations

$$x = 4\sin t \quad y = 3\sin 2t \quad 0 \leq t \leq \frac{\pi}{2}$$

The region R, shown shaded in Figure 2 is bounded by the curve and the x-axis.

- a. i. Show that the area of R is given by

$$\int_0^{\frac{\pi}{2}} 24\sin t \cos^2 t \, dt \quad (3 \text{ marks})$$

- ii. Hence show, by algebraic integration, that the area of R is exactly 8.

(3 marks)

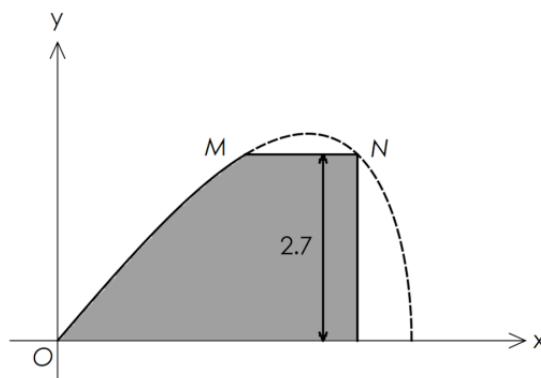


Figure 4

Part of the curve is used to model the profile of a small dam, shown shaded in Figure 4.

Using the model and given that

- x and y are in metres
- the vertical wall of the dam is 2.7 metres high
- there is a horizontal walkway of width MN along the top of the dam

b. calculate the width of the walkway.

(5 marks)

[illegible]

12

A spherical mint of radius 6 mm is placed in the mouth and sucked.

Seven minutes later, the radius of the mint is 2 mm.

In a simple model, the rate of decrease of the radius of the mint is inversely proportional to the square of the radius.

Using the model and all the information given,

- a. find an equation linking the radius of the mint and the time. (You should define the variables that you use.)

(5 marks)

- b. Hence find the total time taken for the mint to completely dissolve. Give your answer in minutes and seconds to the nearest second. **(2 marks)**

(2 marks)

- c. Suggest a limitation of the model (1 mark)

(1 mark)

[illegible]

Q13

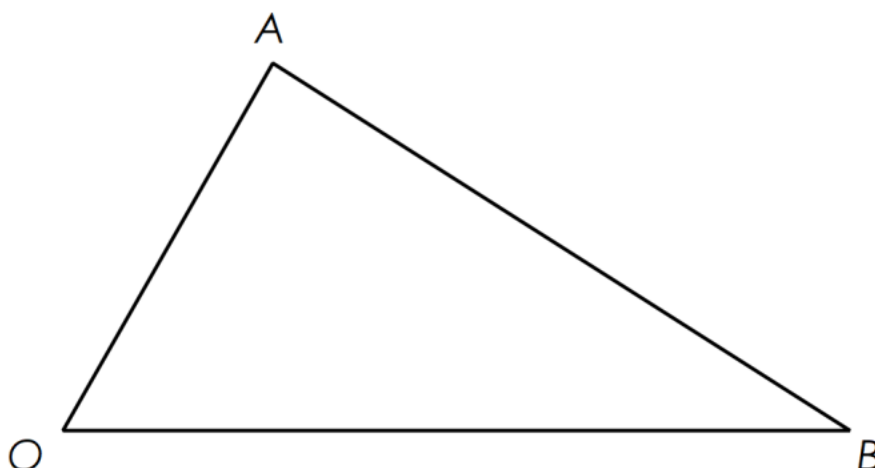


Figure 5

Figure 5 shows a sketch of triangle OAB .

The point C is such that $\overrightarrow{OC} = 3\overrightarrow{OA}$

The point M is the midpoint of AB .

The straight line through C and M cuts OB at the point N .

Given that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$

- Find $\overrightarrow{CM}$ in terms of $\mathbf{a}$ and $\mathbf{b}$ (2 marks)
- Show that $\overrightarrow{ON} = (3 - \frac{5}{2}\lambda)\mathbf{a} + \frac{1}{2}\lambda\mathbf{b}$, where λ is a scalar constant (2 marks)
- Hence prove that $ON : NB = 3 : 2$ (2 marks)

Q14

$$f(x) = x^2, \quad g(x) = -4x + 4, \quad h(x) = 3^x, \quad x > 0$$

Solve the equation

$$h(g(2)) + f^{-1}(h(x)) = 12g^{-1}(h(x))$$

(8 marks)

[illegible]

END OF PAPER