

Practice Paper 1(Pure)

Name:

Total: 100 marks

Time to complete: 2 hours



**MATHSFLEX
TUTORING**
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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

- You should use your A-level formula book if required.
- There are 16 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	
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16	

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Q2

Prove, using algebra, that:

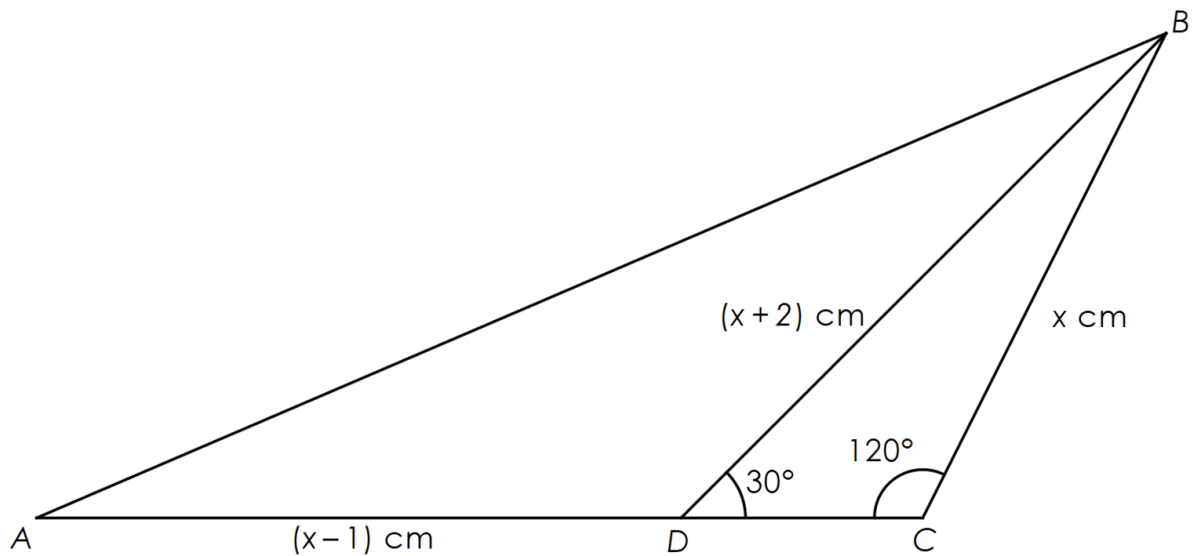
$$n^2 + 3n$$

is even for all $n \in \mathbb{N}$.

(4 marks)

[illegible]

Q3

Figure 1 shows a sketch of triangle ABD and triangle BCD .

Given that

- ADC is a straight line
- $BD = (x + 2)$ cm
- $BC = x$ cm
- angle $BDC = 30^\circ$
- angle $BCD = 120^\circ$

a) show that $x = 2.73$ correct to 3 significant figures.**(3 marks)**Given also that $AD = (x - 1)$ cmb) find the length of AB , giving your answer to 3 significant figures.**(2 marks)**

Q5

The distance a particular car can travel in a journey starting with a full tank of fuel was investigated.

- From a full tank of fuel, 50 litres remained in the car's fuel tank after the car had travelled 50 km
- From a full tank of fuel, 15 litres remained in the car's fuel tank after the car had travelled 225 km

Using a linear model, with V litres being the volume of fuel remaining in the car's fuel tank and d km being the distance the car had travelled,

- a) find an equation linking V with d . (4 marks)

Given that, on a particular journey

- the fuel tank of the car was initially full
- the car continued until it ran out of fuel.

Find, according to the model:

- b) i. the initial volume of fuel that was in the fuel tank of the car,
ii. the distance that the car travelled on this journey. **(3 marks)**

In fact the car travelled 320 km on this journey.

- c) Evaluate the model in light of this information. **(1 mark)**

[illegible]

[illegible]

Q6.

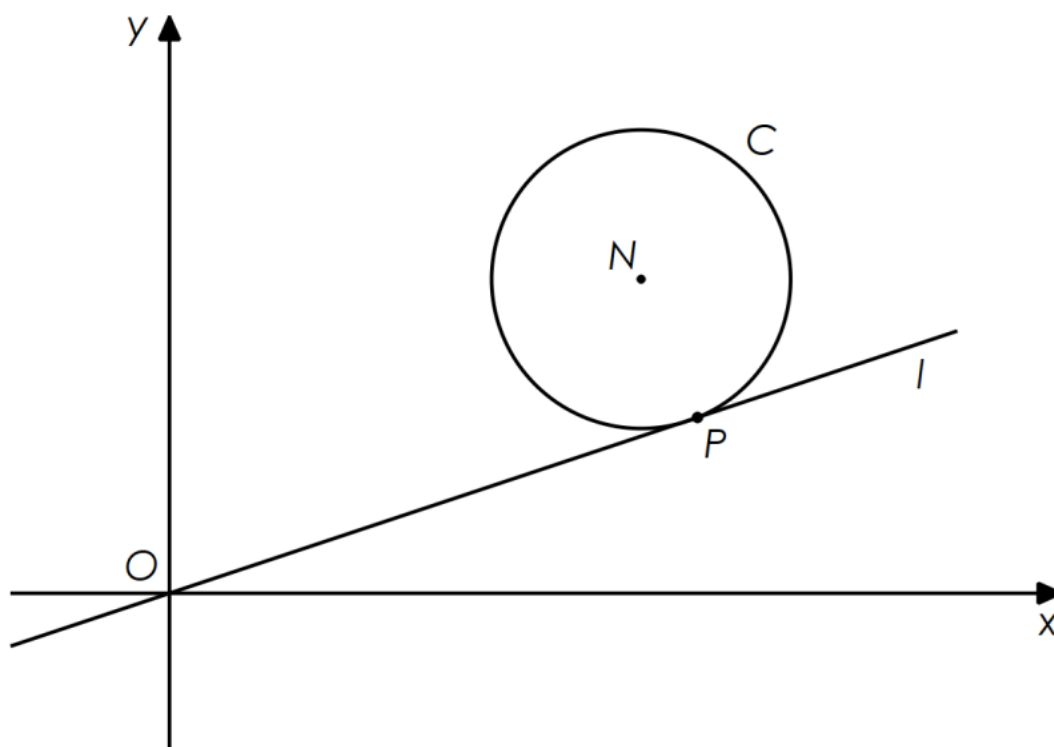


Figure 2 shows a sketch of a circle C with centre $N(8, 5)$

The line l with equation $y = \frac{1}{2}x$ is a tangent to C at the point P .

Find

a) the equation of line PN in the form $y = mx + c$, where m and c are constants, **(2 marks)**

b) an equation for C . **(4 marks)**

The line with equation $y = \frac{-1}{2}x + k$, where k is a non-zero constant, is also a tangent to C .

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

Q7.

In this question you must show detailed reasoning. Solutions relying entirely on calculator technology are not acceptable.

- a. Show that the equation

$$3\tan x = 4\cos x$$

can be written as

$$4\sin^2 x + 3\sin x - 4 = 0$$

(3 marks)

- b. Hence solve, for $0 < x \leq 360^\circ$

$$3\tan x = 4\cos x$$

giving your answers to one decimal place.

(4 marks)

- c. Hence find the number of solutions of the equation

$$3\tan 4x = 4\cos 4x$$

in the interval $0^\circ < x < 1800^\circ$, explaining briefly the reason for your answer. **(1 mark)**

[illegible]

Q8.

- a. Find the first 4 terms, in ascending powers of x , of the binomial expansion of

$$(4 - \frac{3x}{2})^6$$

giving each term in simplest form.

(4 marks)

$$f(x) = \left(\frac{x-4}{3x}\right)\left(4 - \frac{3x}{2}\right)^6$$

- b. Find the coefficient of the x^2 term in the series expansion of $f(x)$, giving your answer as a simplified fraction.

(2 marks)

[illegible]

Q9.

In this question you must show all stages of your working. Solutions relying on calculator technology are not acceptable.

Using algebra, solve the inequality:

$$x^2 - 2x < 15$$

writing your answer in set notation.

(3 marks)

[illegible]

Q10.

The curve C_1 has equation

$$y = \frac{3}{x} + 4$$

- a. i. Sketch C_1 stating the co-ordinates of any points where the curve cuts the co-ordinate axes.
- ii. State the equations of any asymptotes to the curve C_1 . **(3 marks)**

The curve C_2 has equation

$$y = 3x^2 + 7x - 3$$

- b. Show that when C_1 and C_2 intersect when

$$3x^3 + 7x^2 - 7x - 3 = 0$$

(2 marks)

Given that the x co-ordinate of one of the points of intersection is $\frac{-1}{3}$

- c. Use algebra to find the x co-ordinates of the other points of intersection between C_1 and C_2

(4 marks)

[illegible]

Q11.

The triangle PQR is such that $\overrightarrow{PQ} = 4i + 8j$ and $\overrightarrow{PR} = 14i - 17j$.

- a. Find $\overrightarrow{QR}$ (2 marks)

- b. Hence find $|\overrightarrow{QR}|$ as a simplified surd. (2 marks)

The point S lies on the line segment QR so that $QS:SR = 2:3$

- c. Find $\overrightarrow{PS}$ (2 marks)

[illegible]

Q12.

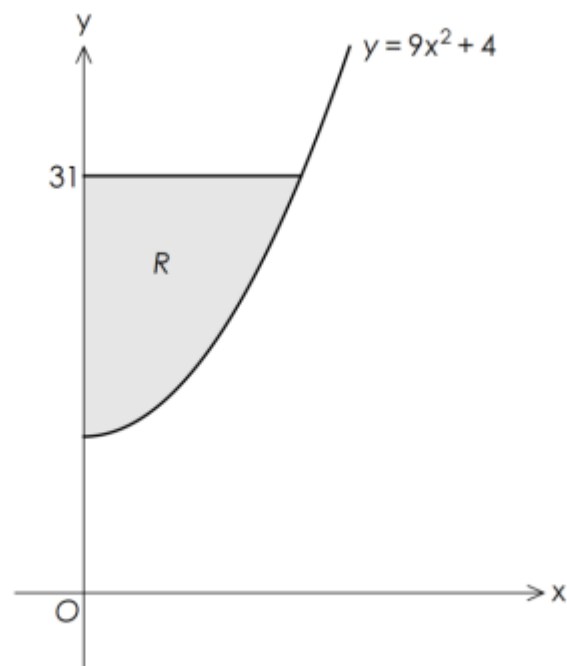


Figure 3

In this question you must show all stages of your working. Solutions relying entirely on calculator technology are not acceptable.

The finite region R, shown shaded in Figure 3, is bounded by the curve with equation $y = 9x^2 + 4$, the y-axis and the line with equation $y = 31$.

Show that the exact area of R is $k\sqrt{3}$ where k is a rational constant to be found.

(5 marks)

13.

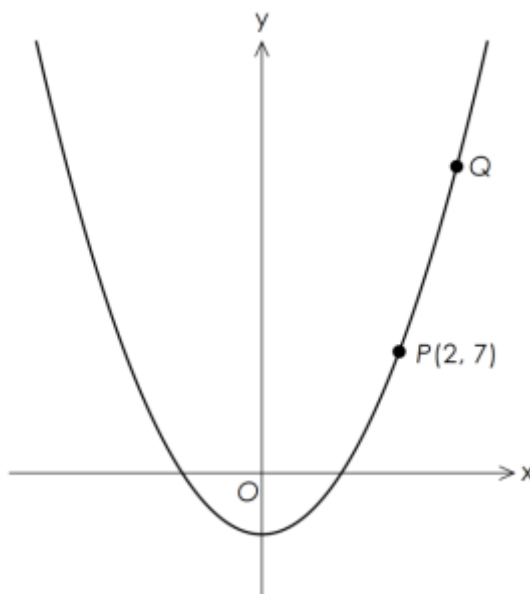


Figure 4 shows part of the curve with equation $y = 3x^2 - 5$.

The point $P(2, 7)$ lies on the curve.

a. Find the gradient of the tangent to the curve at P . **(2 marks)**

The point Q with x coordinate $2 + h$ also lies on the curve.

b. Find the gradient of the line PQ , giving your answer in terms of h in simplest form. **(3 marks)**

c. Explain briefly the relationship between part b and the answer to part a. **(1 mark)**

Q14.

$$g(x) = 2x^3 + 3x^2 - 17x - 30$$

- a. Use the factor theorem to show that $g(x)$ is divisible by $(x - 3)$ **(2 marks)**

- b. Hence, showing all of your working, write $g(x)$ as the product of three linear factors.

(4 marks)

[illegible]

Q15

The temperature, $\theta^\circ\text{C}$, of a cup of tea t minutes after it was placed on a table in a room is modelled by the equation

$$\theta = 16 + 60e^{\frac{-t}{8}} \quad t \geq 0$$

Find, according to the model,

- the temperature of the cup of tea when it was placed on the table, **(1 mark)**
- the value of t , to one decimal place, when the temperature of the tea is 45°C , **(3 marks)**
- Explain why, according to this model, the temperature of the cup of tea could not fall to 15°C . **(1 mark)**

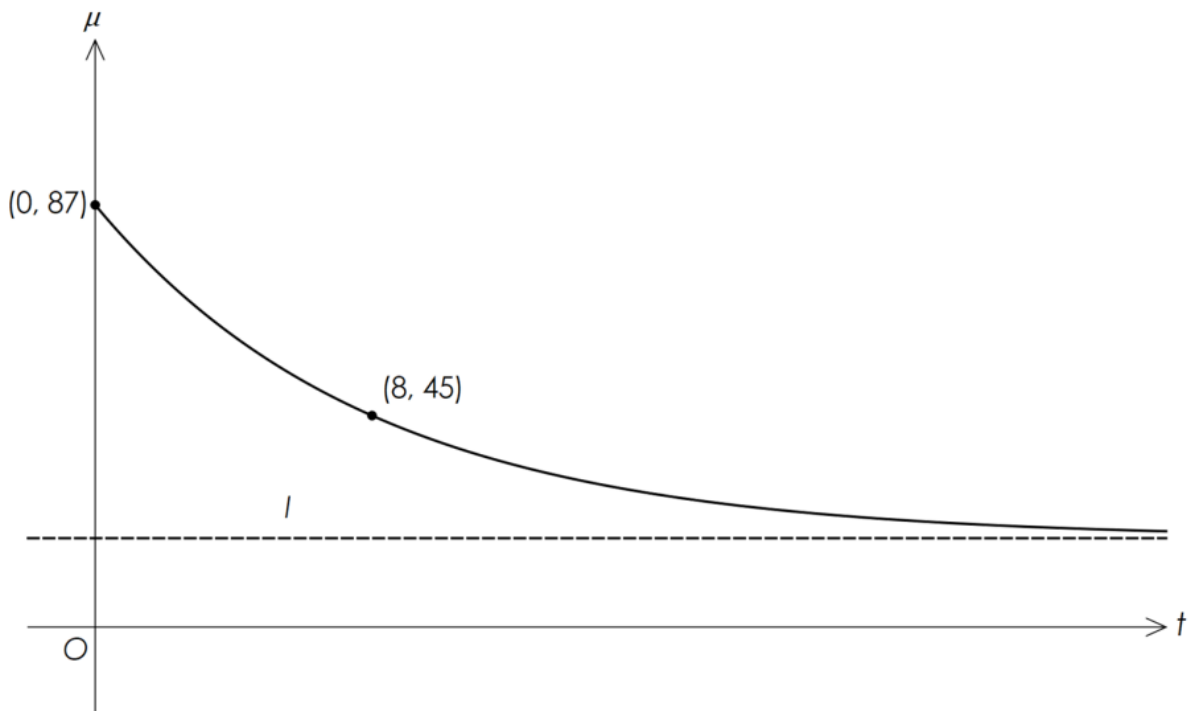


Figure 5

The temperature, $\mu^\circ\text{C}$, of a second cup of tea t minutes after it was placed on a table in a different room, is modelled by the equation

$$\mu = A + Be^{\frac{-t}{8}} \quad t \geq 0$$

Q16

An advertising agency is monitoring the number of views of an online advert.

The equation

$$\log_{10} V = 0.064t + 2.486 \quad 1 \leq t < 30, \quad t \in \mathbb{N}$$

is used to model the total number of views of the advert, V , in the first t days after the advert went live.

a. Show that $V = ab^t$ where a and b are constants to be found.

Give the value of a to the nearest whole number and give the value of b to 3 significant figures.

(4 marks)

b. Interpret, with reference to the model, the value of ab .

(1 mark)

Using this model, calculate

c. the total number of views of the advert in the first 25 days after the advert went live.

Give your answer to 2 significant figures.

(2 marks)

[illegible]

END OF PAPER