



National
Qualifications
2016

X747/76/11

**Mathematics
Paper 1
(Non-Calculator)**

THURSDAY, 12 MAY

INSTRUCTIONS TO CANDIDATES

Candidates should enter their surname, forename(s), date of birth, Scottish candidate number and the name and Level of the subject at the top of their first answer sheet.

Total marks — 60

Attempt ALL questions.

You may NOT use a calculator.

Full credit will be given only to solutions which contain appropriate working.

State the units for your answer where appropriate.

Answers obtained by readings from scale drawings will not receive any credit.

Questions marked with an asterisk differ in some respects from those in the printed paper.

An OW in the margin indicates a new question.

A separate formula sheet is provided.

Attempt ALL questions

Total marks – 60

1. Find the equation of the line passing through the point $(-2, 3)$ which is parallel to the line with equation $y + 4x = 7$. [2 marks]

2. Given that $y = 12x^3 + 8\sqrt{x}$, where $x > 0$, find $\frac{dy}{dx}$. [3 marks]

3. A sequence is defined by the recurrence relation $u_{n+1} = \frac{1}{3}u_n + 10$ with $u_3 = 6$.
 - (a) Find the value of u_4 . [1 mark]
 - (b) Explain why this sequence approaches a limit as $n \rightarrow \infty$. [1 mark]
 - (c) Calculate this limit. [2 marks]

Refer to the diagram for Question 4.

- * 4. The diagram shows a circle with AB as a diameter. A and B are the points $(-7, 3)$ and $(1, 5)$. Find the equation of this circle. [3 marks]

5. Find $\int 8\cos(4x+1) dx$. [2 marks]

6. Functions f and g are defined on \mathbb{R} , the set of real numbers.
The inverse functions f^{-1} and g^{-1} both exist.

(a) Given $f(x) = 3x + 5$, find $f^{-1}(x)$. [3 marks]

(b) If $g(2) = 7$, write down the value of $g^{-1}(7)$. [1 mark]

7. Three vectors can be expressed as follows:

$$\vec{FG} = -2\mathbf{i} - 6\mathbf{j} + 3\mathbf{k}$$

$$\vec{GH} = 3\mathbf{i} + 9\mathbf{j} - 7\mathbf{k}$$

$$\vec{EH} = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$$

(a) Find \vec{FH} . [2 marks]

(b) Hence, or otherwise, find \vec{FE} . [2 marks]

8. Show that the line with equation $y = 3x - 5$ is a tangent to the circle with equation $x^2 + y^2 + 2x - 4y - 5 = 0$ and find the coordinates of the point of contact. [5 marks]

9. (a) Find the x -coordinates of the stationary points on the graph with equation $y = f(x)$, where $f(x) = x^3 + 3x^2 - 24x$. [4 marks]

(b) Hence determine the range of values of x for which the function f is strictly increasing. [2 marks]

Refer to the diagram for Question 10.

- * 10. The diagram shows the graph of the function $f(x) = \log_4 x$, where $x > 0$.

The inverse function, f^{-1} , exists.

Describe the graph of the inverse function stating

- (a) the shape of the graph [1 mark]
- (b) the co-ordinates of two points on the graph. [1 mark]

11. (a) A and C are the points $(1, 3, -2)$ and $(4, -3, 4)$ respectively.

Point B divides AC in the ratio 1 : 2.

Find the coordinates of B. [2 marks]

- (b) $k\vec{AC}$ is a vector of magnitude 1, where $k > 0$.

Determine the value of k . [3 marks]

12. The functions f and g are defined on \mathbb{R} , the set of real numbers by

$$f(x) = 2x^2 - 4x + 5 \quad \text{and} \quad g(x) = 3 - x.$$

- (a) Given $h(x) = f(g(x))$, show that $h(x) = 2x^2 - 8x + 11$. [2 marks]

- (b) Express $h(x)$ in the form $p(x+q)^2 + r$. [3 marks]

Refer to the diagram for Question 13.

- * 13. Triangle ABD is right-angled at B with angles $BAC = p$ and $BAD = q$ and lengths $AB = 4$ units, $BC = 1$ unit, $CD = 2$ units as shown in the diagram.

Show that the exact value of $\cos(q-p)$ is $\frac{19\sqrt{17}}{85}$. [5 marks]

14. (a) Evaluate $\log_5 25$. [1 mark]

(b) Hence solve $\log_4 x + \log_4 (x - 6) = \log_5 25$, where $x > 6$. [5 marks]

Refer to the diagram for Question 15.

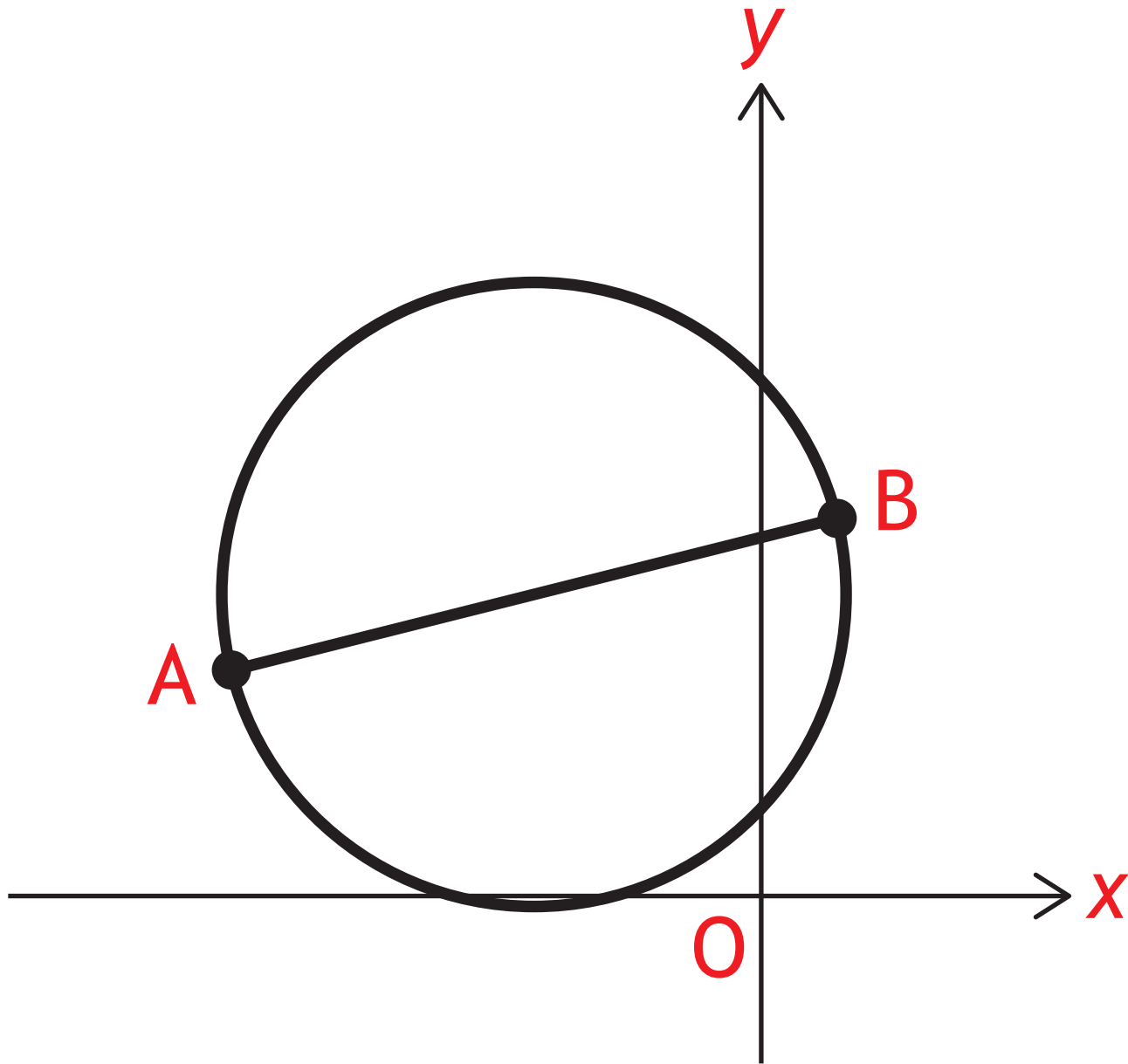
* 15. The diagram shows the graph with equation $y = f(x)$, where $f(x) = k(x - a)(x - b)^2$.

(a) Find the values of a , b and k . [3 marks]

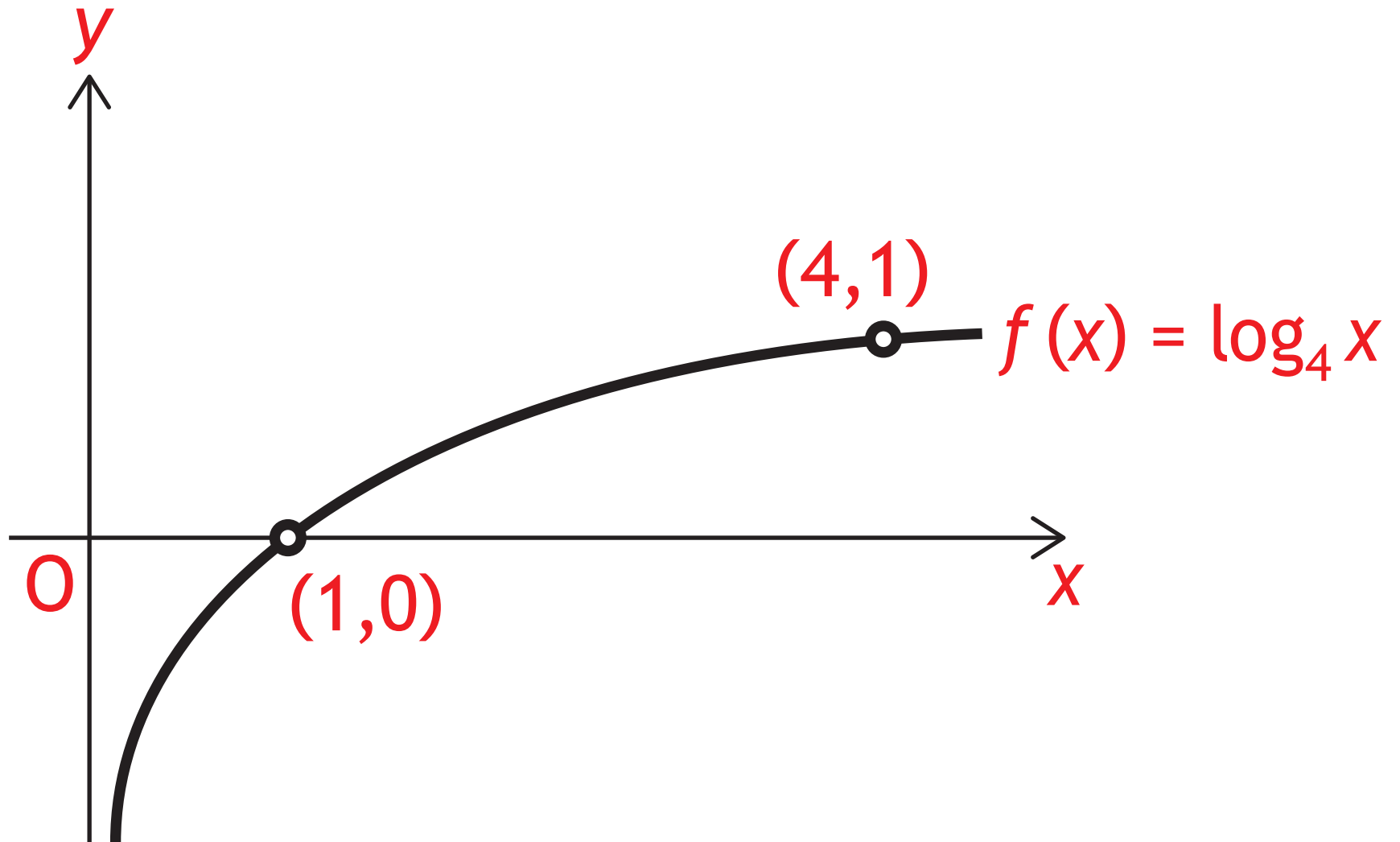
(b) For the function $g(x) = f(x) - d$, where d is positive, determine the range of values of d for which $g(x)$ has exactly one real root. [1 mark]

[END OF QUESTION PAPER]

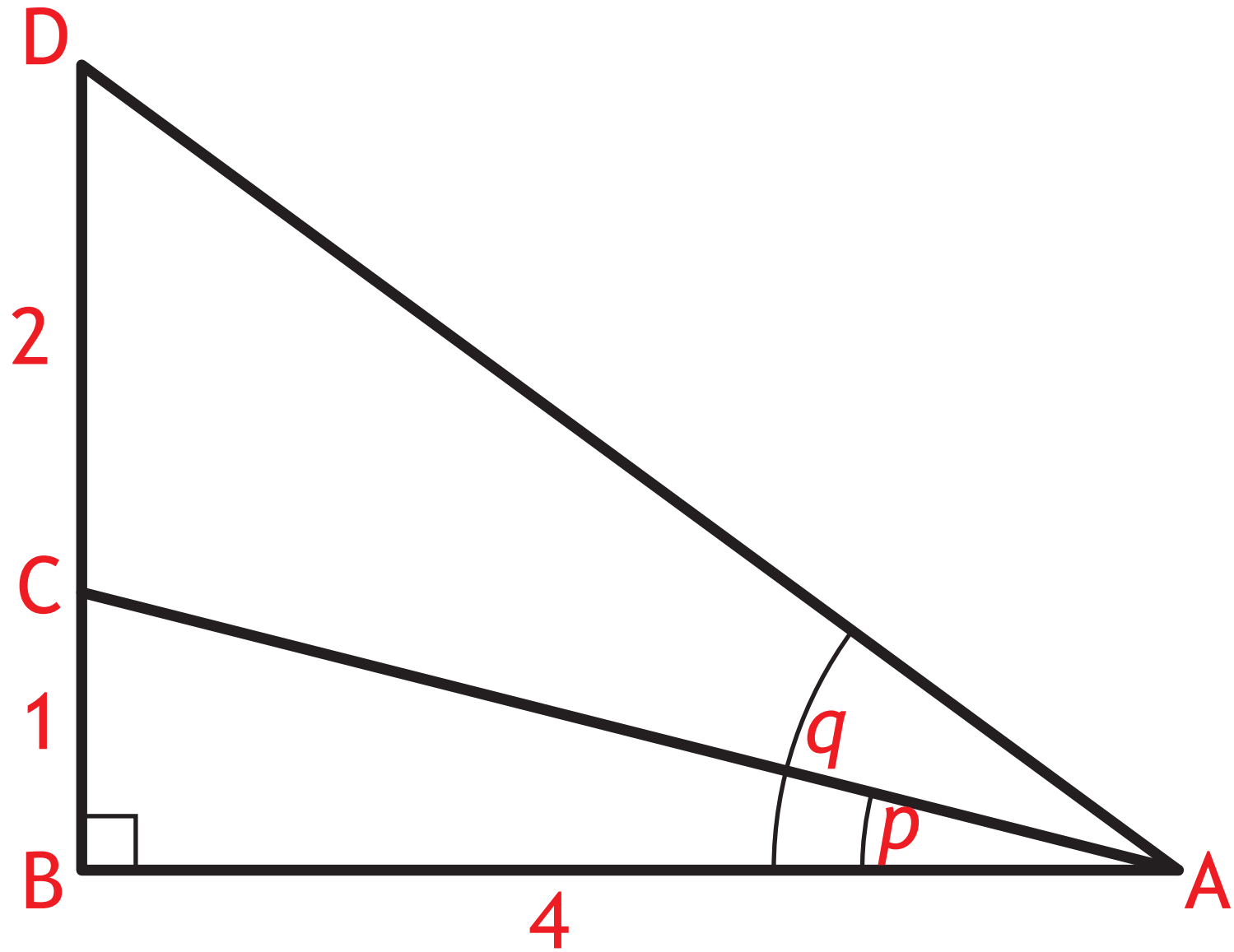
Q4



Q10



Q13



Q15

