

Dr Oliver Mathematics
Mathematics: Higher
2026 Paper 2: Calculator
1 hour 30 minutes

The total number of marks available is 65.

You must write down all the stages in your working.

1. The equation

$$x^2 + kx + (k + 3) = 0$$

(3)

has equal roots.

Find, algebraically, the values of k .

2. Vectors $\mathbf{u}$ and $\mathbf{v}$ are defined as

$$\mathbf{u} = \begin{pmatrix} 3 \\ 2 \\ 6 \end{pmatrix} \text{ and } \mathbf{v} = \begin{pmatrix} -5 \\ -2 \\ 4 \end{pmatrix}.$$

- (a) Find $\mathbf{u} \cdot \mathbf{v}$.

(1)

- (b) Calculate the acute angle between $\mathbf{u}$ and $\mathbf{v}$.

(4)

3. A function, g , is defined on $\mathbb{R}$, the set of real numbers, by

(3)

$$g(x) = \frac{1}{5}x + 6.$$

Find the inverse function, $g^{-1}(x)$.

4. A circle has centre $(-2, 5)$.

(2)

The point $(3, 7)$ lies on the circle.

Find the equation of the circle.

5. A sequence is defined by the recurrence relation

$$u_{n+1} = 1.125u_n + 5, u_0 = 2.$$

- (a) Calculate the value of u_1 .

(1)

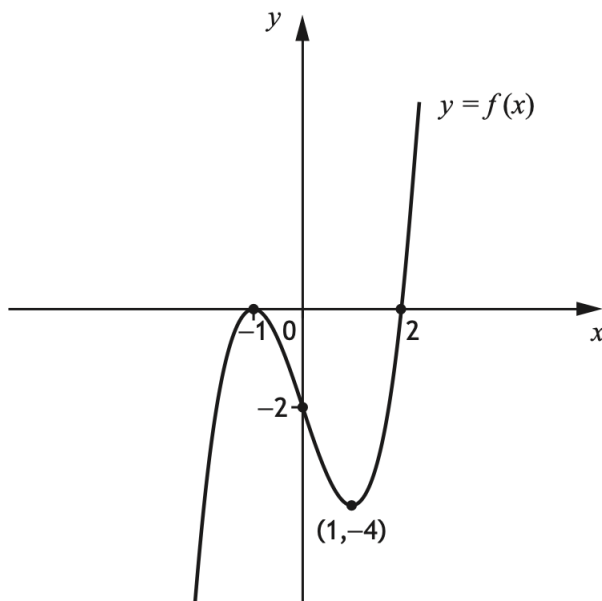
- (b) Explain why this sequence does not approach a limit as $n \rightarrow \infty$.

(1)

- (c) Determine the smallest value of n for which $u_n > 30$.

(2)

6. The diagram shows the graph of a cubic function $y = f(x)$ with stationary points at $(-1, 0)$ and $(1, -4)$. (3)

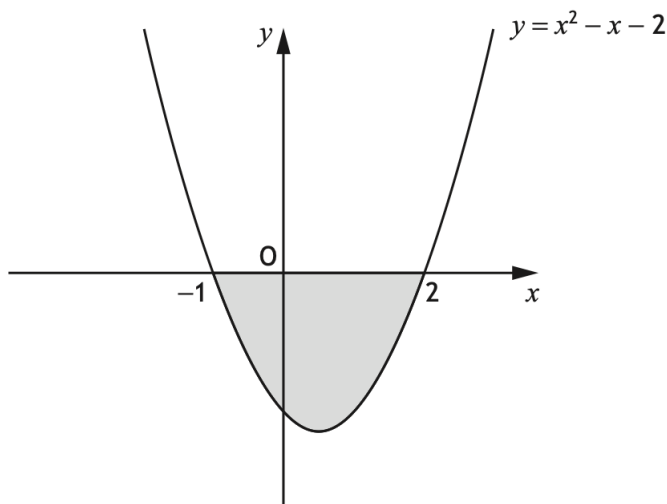


On the diagram in your answer booklet, sketch the graph of

$$y = -f(x) + 1.$$

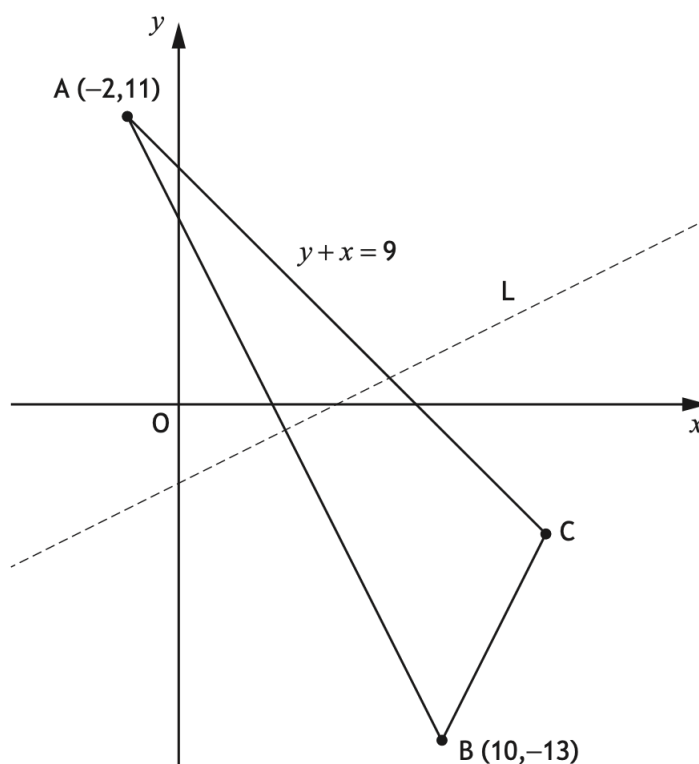
7. The diagram shows the curve with equation (4)

$$y = x^2 - x - 2.$$



Calculate the shaded area.

8. A and B are the points $(-2, 11)$ and $(10, -13)$.



- (a) Find the equation of L , the perpendicular bisector of AB .

(4)

The equation of AC is

$$y + x = 9.$$

- (b) Calculate the size of the obtuse angle between L and AC .

(2)

9. Determine the range of values of x for which the function

(4)

$$f(x) = 4x^3 - 12x^2 + 7$$

strictly decreasing.

Justify your answer.

10. Solve the equation

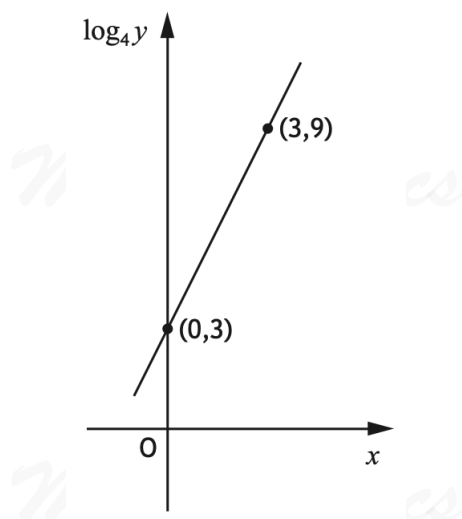
(5)

$$3 \cos 2x^\circ + 10 \cos x^\circ = 1, \text{ where } 0 \leq x < 360.$$

11. Two variables x and y are connected by the equation (5)

$$y = ab^x.$$

The graph of $\log_4 y$ against x is a straight line as shown.



Find the values of a and b .

12. A function f is defined on the set of real numbers by

$$f(x) = x^3 + 2x^2 - 4x + 1.$$

- (a) Find the x -coordinates of the stationary points on the curve with equation $y = f(x)$. (3)
 (b) Hence, determine the maximum and minimum values of $f(x)$ in the interval (3)

$$-1 \leq x \leq 1.$$

13. (a) Express (4)

$$2 \sin x^\circ - 7 \cos x^\circ$$

in the form

$$k \sin(x - a)^\circ,$$

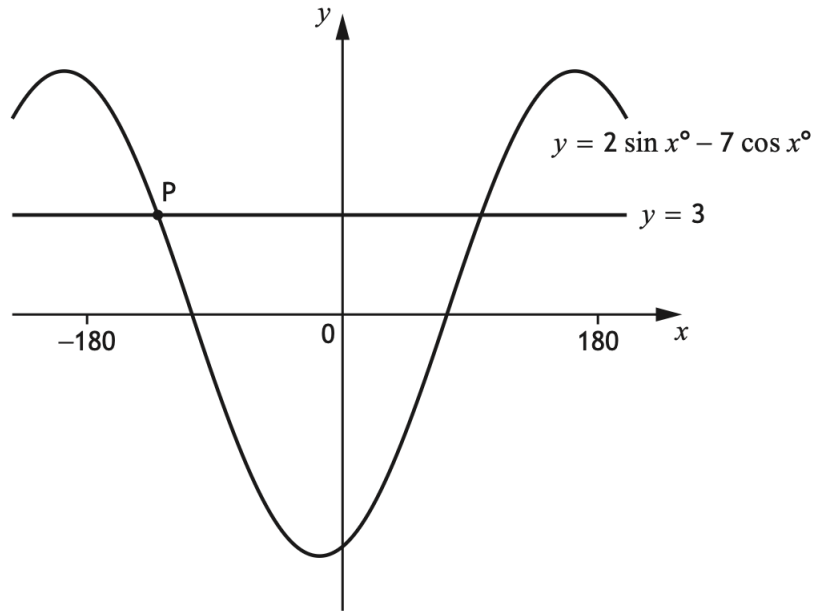
where $k > 0$ and $0 < a < 360$.

The diagram shows part of the curve with equation

$$y = 2 \sin x^\circ - 7 \cos x^\circ$$

and the line with equation $y = 3$.

The curve and the line intersect at the point P .



(b) Find the x -coordinate of P .

(3)

14. During a metal-working process a heated steel rod is cooled by dropping it into a container of oil.

The temperature of the rod is given by

$$T = 800 e^{-0.124t} + 25,$$

where T is the temperature of the rod, in degrees Celsius, t seconds after it is dropped into the oil.

(a) Determine the temperature of the rod as it is dropped into the oil.

(1)

(b) Calculate the time taken for the temperature of the rod to cool to 150°C .

(4)

15. Express

$$(3 \sin \theta + \cos \theta)(\sin \theta + 3 \cos \theta)$$

(3)

in the form

$$a + b \sin c\theta,$$

where a , b , and c are integers.

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