







2. Given that

$$f(x) = \ln x, \quad x > 0$$

sketch on separate axes the graphs of

(i)  $y = f(x)$ ,

(ii)  $y = |f(x)|$ ,

(iii)  $y = -f(x - 4)$ .

Show, on each diagram, the point where the graph meets or crosses the  $x$ -axis.  
In each case, state the equation of the asymptote.

(7)



**Question 2 continued**



**Question 2 continued**



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**Question 2 continued**

**Q2**

**(Total 7 marks)**







































7. The function  $f$  has domain  $-2 \leq x \leq 6$  and is linear from  $(-2, 10)$  to  $(2, 0)$  and from  $(2, 0)$  to  $(6, 4)$ . A sketch of the graph of  $y = f(x)$  is shown in Figure 1.

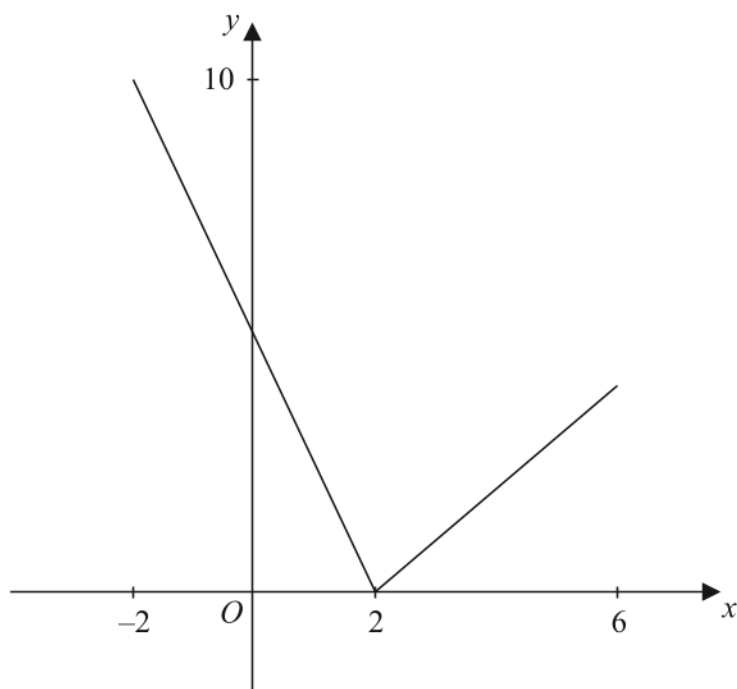


Figure 1

- (a) Write down the range of  $f$ . (1)
- (b) Find  $ff(0)$ . (2)

The function  $g$  is defined by

$$g : x \rightarrow \frac{4 + 3x}{5 - x}, \quad x \in \mathbb{R}, \quad x \neq 5$$

- (c) Find  $g^{-1}(x)$  (3)
- (d) Solve the equation  $gf(x) = 16$  (5)

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8.

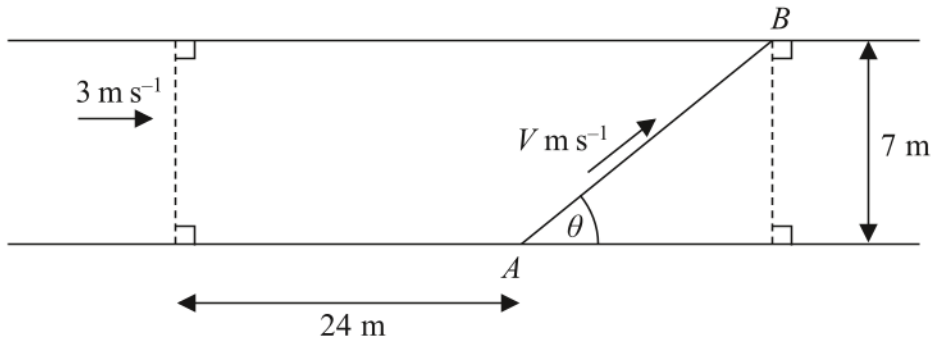


Figure 2

Kate crosses a road, of constant width 7 m, in order to take a photograph of a marathon runner, John, approaching at  $3 \text{ m s}^{-1}$ .

Kate is 24 m ahead of John when she starts to cross the road from the fixed point  $A$ .

John passes her as she reaches the other side of the road at a variable point  $B$ , as shown in Figure 2.

Kate's speed is  $V \text{ m s}^{-1}$  and she moves in a straight line, which makes an angle  $\theta$ ,  $0 < \theta < 150^\circ$ , with the edge of the road, as shown in Figure 2.

You may assume that  $V$  is given by the formula

$$V = \frac{21}{24 \sin \theta + 7 \cos \theta}, \quad 0 < \theta < 150^\circ$$

- (a) Express  $24 \sin \theta + 7 \cos \theta$  in the form  $R \cos(\theta - \alpha)$ , where  $R$  and  $\alpha$  are constants and where  $R > 0$  and  $0 < \alpha < 90^\circ$ , giving the value of  $\alpha$  to 2 decimal places. (3)

Given that  $\theta$  varies,

- (b) find the minimum value of  $V$ . (2)

Given that Kate's speed has the value found in part (b),

- (c) find the distance  $AB$ . (3)

Given instead that Kate's speed is  $1.68 \text{ m s}^{-1}$ ,

- (d) find the two possible values of the angle  $\theta$ , given that  $0 < \theta < 150^\circ$ . (6)

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