

Write your name here

Surname

Other Names

# AS/A Level Mathematics

## R Formulae

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### 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.
- Answers should be given to three significant figures unless otherwise stated.

### Information

- 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.

1

$$f(x) = 3 \cos x - 4 \sin x$$

Given that  $f(x) = R \cos(x + \alpha)$ , where  $R > 0$  and  $0 \leq \alpha \leq 90$ ,

(a) Find the value of  $R$  and the value of  $\alpha$  (4)

(b) Hence solve, for  $0 \leq \theta \leq 360$ , the equation

$$3 \cos x - 4 \sin x = 1$$

Give your answers to 1 decimal place. (5)

(c) Write down the minimum value of  $3 \cos x - 4 \sin x$  (1)

(d) Find, to 1 decimal place, the smallest positive value of  $x$  for which this minimum occurs (2)

**(Total for question 1 is 12 marks)**

2

(a) Express  $5 \sin x + 12 \cos x$  in the form  $R \sin(x + \alpha)$ , where  $R > 0$  and  $0 \leq \alpha \leq 90$  (4)

(b) Hence find the maximum value of  $5 \sin x + 12 \cos x$  and find, the smallest positive value of  $x$  for which this maximum occurs (3)

**(Total for question 2 is 7 marks)**

3

$$f(x) = 5 \cos \theta + \sin \theta$$

Given that  $f(x) = R \cos(\theta - \alpha)$ , where  $R > 0$  and  $0 \leq \alpha \leq \frac{\pi}{2}$

(a) Find the value of  $R$  and the value of  $\alpha$  to 3 decimal places (4)

(b) Hence, solve for  $0 \leq \theta \leq 2\pi$ , the equation

$$5 \cos \theta + \sin \theta = 2$$
 (3)

(c) Calculate the minimum value of

$$5 \cos 4x + \sin 4x + 15$$
 (2)

(d) Find the smallest positive value of  $x$  for which this minimum occurs (3)

**(Total for question 3 is 12 marks)**

4

(a) Express  $2 \sin x - 3 \cos x$  in the form  $R \sin(x - \alpha)$ , where  $R > 0$  and  $0 \leq \alpha \leq \frac{\pi}{2}$  (4)

(b) Hence find the greatest value of  $(2 \sin x - 3 \cos x)^2$  and find, the smallest positive value of  $x$  for which this maximum occurs (2)

(c) Solve, for  $0 \leq \theta \leq 2\pi$ ,

$$2 \sin x - 3 \cos x = 1$$

Give your answers to 3 decimal places. (5)

**(Total for question 4 is 11 marks)**