

GCE Examinations  
Advanced Subsidiary

## Core Mathematics C2

Paper K

Time: 1 hour 30 minutes

### *Instructions and Information*

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Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration.

Full marks may be obtained for answers to ALL questions.

Mathematical formulae and statistical tables are available.

This paper has nine questions.

### *Advice to Candidates*

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You must show sufficient working to make your methods clear to an examiner.  
Answers without working may gain no credit.



*Written by Shaun Armstrong*

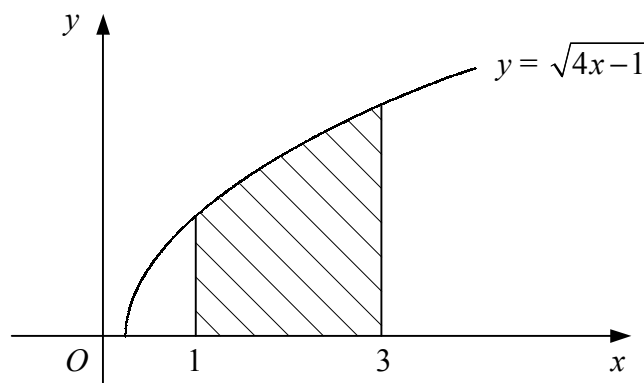
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1. Evaluate

$$\int_1^4 (x^2 - 5x + 4) \, dx. \quad (4)$$

2.



**Figure 1**

Figure 1 shows the curve with equation  $y = \sqrt{4x-1}$ .

Use the trapezium rule with five equally-spaced ordinates to estimate the area of the shaded region bounded by the curve, the  $x$ -axis and the lines  $x = 1$  and  $x = 3$ . (4)

3. (a) Given that  $y = \log_2 x$ , find expressions in terms of  $y$  for

- (i)  $\log_2 \left( \frac{x}{2} \right)$ ,
- (ii)  $\log_2 (\sqrt{x})$ . (4)

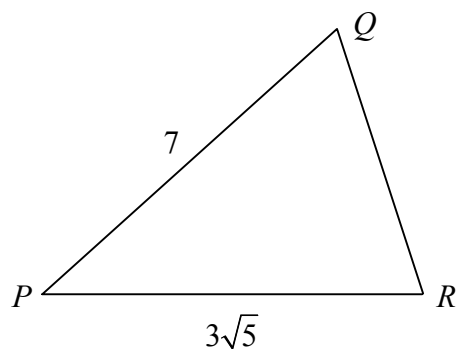
(b) Hence, or otherwise, solve the equation

$$2 \log_2 \left( \frac{x}{2} \right) + \log_2 (\sqrt{x}) = 8. \quad (3)$$

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

- (a) Show that  $f(x)$  is decreasing for all values of  $x$ . (4)
- (b) Verify that the point  $(1, 0)$  lies on the curve  $y = f(x)$ . (1)
- (c) Find the area of the region bounded by the curve  $y = f(x)$  and the coordinate axes. (4)

5.



**Figure 2**

Figure 2 shows triangle  $PQR$  in which  $PQ = 7$  and  $PR = 3\sqrt{5}$ .

Given that  $\sin(\angle QPR) = \frac{2}{3}$  and that  $\angle QPR$  is acute,

(a) find the exact value of  $\cos(\angle QPR)$  in its simplest form, (2)

(b) show that  $QR = 2\sqrt{6}$ , (4)

(c) find  $\angle PQR$  in degrees to 1 decimal place. (3)

6. The polynomial  $p(x)$  is defined by

$$p(x) = 2x^3 + x^2 + ax + b,$$

where  $a$  and  $b$  are constants.

Given that when  $p(x)$  is divided by  $(x + 2)$  there is a remainder of 20,

(a) find an expression for  $b$  in terms of  $a$ . (2)

Given also that  $(x + 3)$  is a factor of  $p(x)$ ,

(b) find the values of  $a$  and  $b$ , (4)

(c) fully factorise  $p(x)$ . (4)

**Turn over**

7. (a) Find, to 2 decimal places, the values of  $x$  in the interval  $0 \leq x < 2\pi$  for which

$$\tan\left(x + \frac{\pi}{4}\right) = 3. \quad (4)$$

- (b) Find, in terms of  $\pi$ , the values of  $y$  in the interval  $0 \leq y < 2\pi$  for which

$$2 \sin y = \tan y. \quad (6)$$

8. The point  $A$  has coordinates  $(4, 6)$ .

Given that  $OA$ , where  $O$  is the origin, is a diameter of circle  $C$ ,

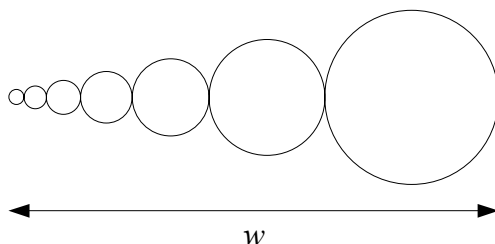
- (a) find an equation for  $C$ . (4)

Circle  $C$  crosses the  $x$ -axis at  $O$  and at the point  $B$ .

- (b) Find the coordinates of  $B$ . (2)

- (c) Find an equation for the tangent to  $C$  at  $B$ , giving your answer in the form  $ax + by = c$ , where  $a$ ,  $b$  and  $c$  are integers. (5)

9.



**Figure 3**

Figure 3 shows part of a design being produced by a computer program.

The program draws a series of circles with each one touching the previous one and such that their centres lie on a horizontal straight line.

The radii of the circles form a geometric sequence with first term 1 mm and second term 1.5 mm. The width of the design is  $w$  as shown.

- (a) Find the radius of the fourth circle to be drawn. (2)

- (b) Show that when eight circles have been drawn,  $w = 98.5$  mm to 3 significant figures. (4)

- (c) Find the total area of the design in square centimetres when ten circles have been drawn. (5)

**END**

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