

**Solomon Press**  
**Core Mathematics C4**  
**Paper J**  
**(Question Paper)**

**All exam papers are issued free to students for education purpose only.**  
**Mr.S.V.Swarnaraja (Marking Examiner, Team Leader & Author)**  
**www.swanash.com, Mobile: +94777304755 , email: swa@swanash.com**

GCE Examinations  
Advanced Subsidiary

## Core Mathematics C4

Paper J

Time: 1 hour 30 minutes

### *Instructions and Information*

---

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 eight questions.

### *Advice to Candidates*

---

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



*Written by Shaun Armstrong*

© Solomon Press

*These sheets may be copied for use solely by the purchaser's institute.*



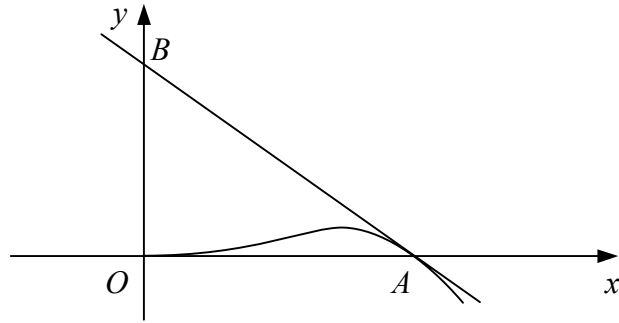
2. Use the substitution  $u = 1 - x^{\frac{1}{2}}$  to find

$$\int \frac{1}{1-x^{\frac{1}{2}}} dx. \quad (6)$$

Lined writing area with 25 horizontal lines.



4.



**Figure 1**

Figure 1 shows the curve with parametric equations

$$x = a\sqrt{t}, \quad y = at(1 - t), \quad t \geq 0,$$

where  $a$  is a positive constant.

- (a) Find  $\frac{dy}{dx}$  in terms of  $t$ . (3)

The curve meets the  $x$ -axis at the origin,  $O$ , and at the point  $A$ . The tangent to the curve at  $A$  meets the  $y$ -axis at the point  $B$  as shown.

- (b) Show that the area of triangle  $OAB$  is  $a^2$ . (6)

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

5. The gradient at any point  $(x, y)$  on a curve is proportional to  $\sqrt{y}$  .

Given that the curve passes through the point with coordinates  $(0, 4)$ ,

(a) show that the equation of the curve can be written in the form

$$2\sqrt{y} = kx + 4,$$

where  $k$  is a positive constant. (5)

Given also that the curve passes through the point with coordinates  $(2, 9)$ ,

(b) find the equation of the curve in the form  $y = f(x)$ . (4)

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

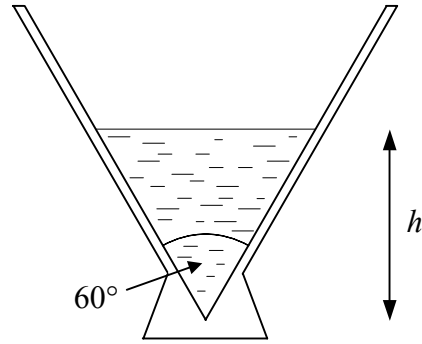
---

---

---

---

6.



**Figure 2**

Figure 2 shows a vertical cross-section of a vase.

The inside of the vase is in the shape of a right-circular cone with the angle between the sides in the cross-section being  $60^\circ$ . When the depth of water in the vase is  $h$  cm, the volume of water in the vase is  $V$  cm<sup>3</sup>.

(a) Show that  $V = \frac{1}{9} \pi h^3$ . (3)

The vase is initially empty and water is poured in at a constant rate of  $120 \text{ cm}^3 \text{ s}^{-1}$ .

(b) Find, to 2 decimal places, the rate at which  $h$  is increasing

(i) when  $h = 6$ ,

(ii) after water has been poured in for 8 seconds. (7)

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---



7. Relative to a fixed origin, the points  $A$  and  $B$  have position vectors  $\begin{pmatrix} -4 \\ 1 \\ 3 \end{pmatrix}$  and  $\begin{pmatrix} -3 \\ 6 \\ 1 \end{pmatrix}$  respectively.

(a) Find a vector equation for the line  $l_1$  which passes through  $A$  and  $B$ . **(2)**

The line  $l_2$  has vector equation

$$\mathbf{r} = \begin{pmatrix} 3 \\ -7 \\ 9 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ -3 \\ 1 \end{pmatrix}.$$

(b) Show that lines  $l_1$  and  $l_2$  do not intersect. **(5)**

(c) Find the position vector of the point  $C$  on  $l_2$  such that  $\angle ABC = 90^\circ$ . **(6)**

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

8.  $f(x) = \frac{x(3x-7)}{(1-x)(1-3x)}, |x| < \frac{1}{3}.$

(a) Find the values of the constants  $A$ ,  $B$  and  $C$  such that

$$f(x) = A + \frac{B}{1-x} + \frac{C}{1-3x}. \quad (4)$$

(b) Evaluate

$$\int_0^{\frac{1}{4}} f(x) \, dx,$$

giving your answer in the form  $p + \ln q$ , where  $p$  and  $q$  are rational. (5)

(c) Find the series expansion of  $f(x)$  in ascending powers of  $x$  up to and including the term in  $x^3$ , simplifying each coefficient. (5)

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---