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1. Evaluate  $\int_1^8 \frac{1}{\sqrt{x}} dx$ , giving your answer in the form  $a + b\sqrt{2}$ , where  $a$  and  $b$  are integers.

(4)

Lined writing area for the student's answer.

(Total 4 marks)

Q1

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**2.**

$$f(x) = 3x^3 - 5x^2 - 16x + 12.$$

(a) Find the remainder when  $f(x)$  is divided by  $(x - 2)$ .

**(2)**

Given that  $(x + 2)$  is a factor of  $f(x)$ ,

(b) factorise  $f(x)$  completely.

**(4)**

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**(Total 6 marks)**

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**Q2**

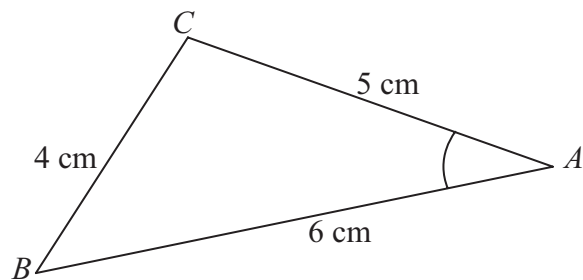






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**Figure 1**

Figure 1 shows the triangle  $ABC$ , with  $AB = 6$  cm,  $BC = 4$  cm and  $CA = 5$  cm.

(a) Show that  $\cos A = \frac{3}{4}$ .

**(3)**

(b) Hence, or otherwise, find the exact value of  $\sin A$ .

**(2)**

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Question 4 continued

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Q4

(Total 5 marks)



5. The curve  $C$  has equation

$$y = x\sqrt{x^3+1}, \quad 0 \leq x \leq 2.$$

- (a) Complete the table below, giving the values of  $y$  to 3 decimal places at  $x = 1$  and  $x = 1.5$ .

$x$	0	0.5	1	1.5	2
$y$	0	0.530			6

(2)

- (b) Use the trapezium rule, with all the  $y$  values from your table, to find an approximation for the value of  $\int_0^2 x\sqrt{x^3+1} dx$ , giving your answer to 3 significant figures.

(4)

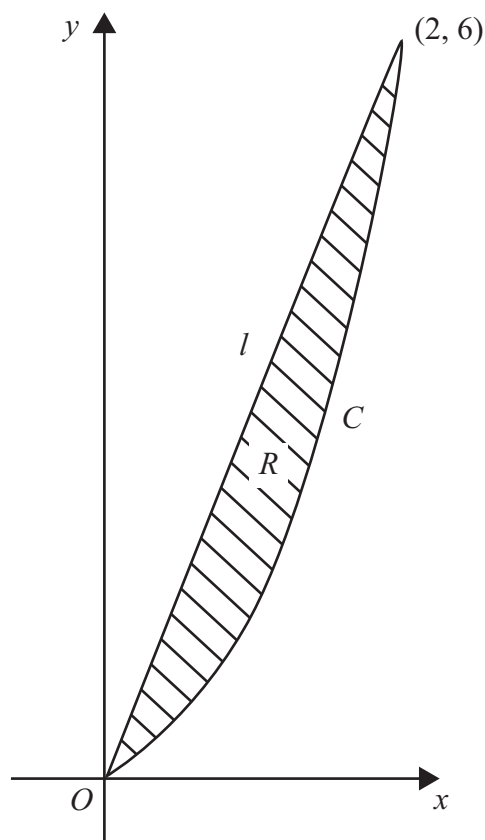


Figure 2

Figure 2 shows the curve  $C$  with equation  $y = x\sqrt{x^3+1}$ ,  $0 \leq x \leq 2$ , and the straight line segment  $l$ , which joins the origin and the point  $(2, 6)$ . The finite region  $R$  is bounded by  $C$  and  $l$ .

- (c) Use your answer to part (b) to find an approximation for the area of  $R$ , giving your answer to 3 significant figures.

(3)









**Question 5 continued**

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**Question 6 continued**

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Q6

(Total 6 marks)



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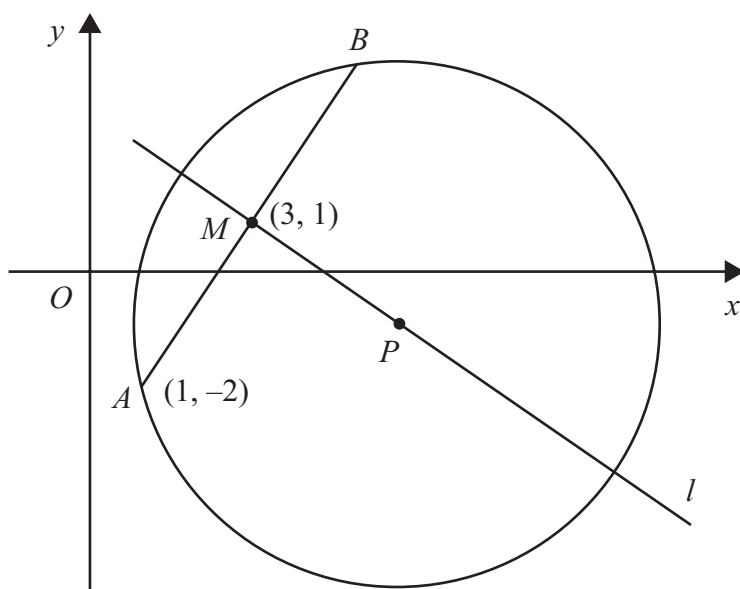


Figure 3

The points  $A$  and  $B$  lie on a circle with centre  $P$ , as shown in Figure 3. The point  $A$  has coordinates  $(1, -2)$  and the mid-point  $M$  of  $AB$  has coordinates  $(3, 1)$ . The line  $l$  passes through the points  $M$  and  $P$ .

(a) Find an equation for  $l$ . (4)

Given that the  $x$ -coordinate of  $P$  is 6,

(b) use your answer to part (a) to show that the  $y$ -coordinate of  $P$  is  $-1$ , (1)

(c) find an equation for the circle. (4)

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**8.** A trading company made a profit of £50 000 in 2006 (Year 1).

A model for future trading predicts that profits will increase year by year in a geometric sequence with common ratio  $r$ ,  $r > 1$ .

The model therefore predicts that in 2007 (Year 2) a profit of £50 000 $r$  will be made.

(a) Write down an expression for the predicted profit in Year  $n$ . **(1)**

The model predicts that in Year  $n$ , the profit made will exceed £200 000.

(b) Show that  $n > \frac{\log 4}{\log r} + 1$ . **(3)**

Using the model with  $r = 1.09$ ,

(c) find the year in which the profit made will first exceed £200 000, **(2)**

(d) find the total of the profits that will be made by the company over the 10 years from 2006 to 2015 inclusive, giving your answer to the nearest £10 000. **(3)**

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9. (a) Sketch, for  $0 \leq x \leq 2\pi$ , the graph of  $y = \sin\left(x + \frac{\pi}{6}\right)$ . (2)

(b) Write down the exact coordinates of the points where the graph meets the coordinate axes. (3)

(c) Solve, for  $0 \leq x \leq 2\pi$ , the equation

$$\sin\left(x + \frac{\pi}{6}\right) = 0.65,$$

giving your answers in radians to 2 decimal places. (5)

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**Question 9 continued**

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Q9



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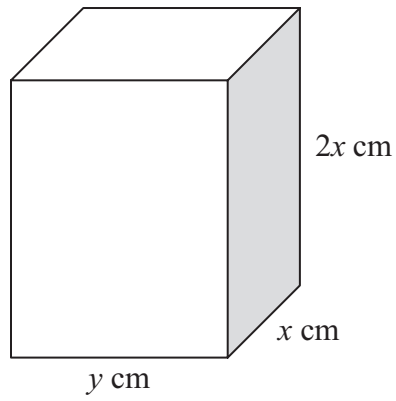


Figure 4

Figure 4 shows a solid brick in the shape of a cuboid measuring  $2x$  cm by  $x$  cm by  $y$  cm.

The total surface area of the brick is  $600 \text{ cm}^2$ .

(a) Show that the volume,  $V \text{ cm}^3$ , of the brick is given by

$$V = 200x - \frac{4x^3}{3}.$$

(4)

Given that  $x$  can vary,

(b) use calculus to find the maximum value of  $V$ , giving your answer to the nearest  $\text{cm}^3$ .

(5)

(c) Justify that the value of  $V$  you have found is a maximum.

(2)

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**Question 10 continued**

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