

**Dr Oliver Mathematics**  
**Cambridge O Level Additional Mathematics**  
**2008 November Paper 2: Calculator**  
**2 hours**

The total number of marks available is 80.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

You must write down all the stages in your working.

1. Given that

$$\mathbf{A} = \begin{pmatrix} 13 & 6 \\ 7 & 4 \end{pmatrix},$$

find the inverse matrix  $\mathbf{A}^{-1}$  and hence solve the simultaneous equations

$$13x + 6y = 41$$

$$7x + 4y = 24.$$

2. Variables  $x$  and  $y$  are connected by the equation

$$y = (2x - 9)^3.$$

Given that  $x$  is increasing at the rate of 4 units per second, find the rate of increase of  $y$  when  $x = 7$ .

3. Find the set of values of  $m$  for which the line

$$y = mx + 2$$

does not meet the curve

$$y = x^2 - 5x + 18.$$

4. (a) Differentiate

$$x \ln x$$

with respect to  $x$ .

- (b) Hence find

$$\int \ln x \, dx.$$

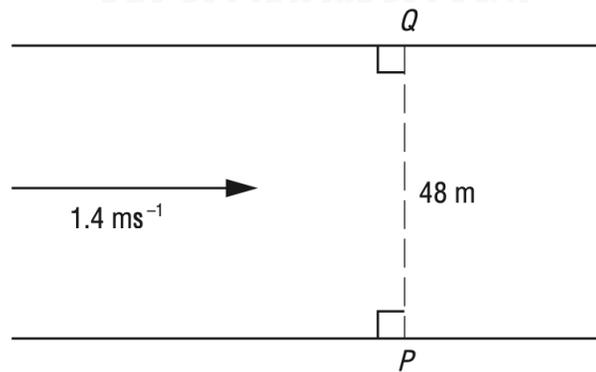
5. Solve the equation

$$(a) \frac{4^x}{2^{5-x}} = \frac{2^{4x}}{8^{x-3}}.$$

- (b)  $\log_{10}(2y + 10) + \log_{10} y = 2$ . (3)
6. (a) A sports team of 3 attackers, 2 centres and 4 defenders is to be chosen from a squad of 5 attackers, 3 centres and 6 defenders. (3)

Calculate the number of different ways in which this can be done.

- (b) How many different 4-digit numbers greater than 3 000 can be formed using the six digits 1, 2, 3, 4, 5, and 6 if no digit can be used more than once? (3)
7. The diagram shows a river with parallel banks.



The river is 48 m wide and is flowing with a speed of  $1.4 \text{ ms}^{-1}$ .

A boat travels in a straight line from a point  $P$  on one bank to a point  $Q$  which is on the other bank directly opposite  $P$ .

Given that the boat takes 10 seconds to cross the river, find

- (a) the speed of the boat in still water, (4)
- (b) the angle to the bank at which the boat should be steered. (2)
8. The function  $f$  is defined, for  $0 \leq x \leq 2\pi$ , by

$$f(x) = 3 + 5 \sin 2x.$$

State

- (a) the amplitude of  $f$ , (1)
- (b) the period of  $f$ , (1)
- (c) the maximum and minimum values of  $f$ . (2)
- (d) Sketch the graph of  $y = f(x)$ . (3)

9. The line

$$y = 2x - 9$$

(8)

intersects the curve

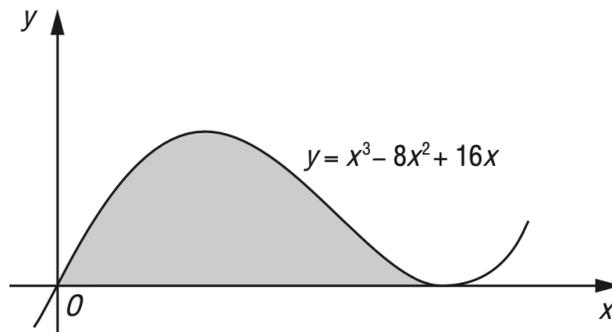
$$x^2 + y^2 + xy + 3x = 46$$

at the points  $A$  and  $B$ .

Find the equation of the perpendicular bisector of  $AB$ .

10. The diagram shows part of the curve

$$y = x^3 - 8x^2 + 16x.$$



(a) Show that the curve has a minimum point at  $(4, 0)$  and find the coordinates of the maximum point. (4)

(b) Find the area of the shaded region enclosed by the  $x$ -axis and the curve. (4)

11. The table shows experimental values of two variables  $x$  and  $y$ .

$x$	2	4	6	8
$y$	2.25	0.81	0.47	0.33

(a) Using graph paper, plot  $xy$  against  $\frac{1}{x}$  and draw a straight line graph. (3)

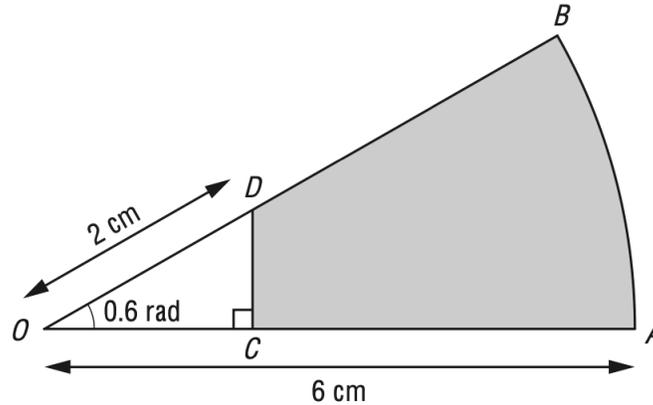
(b) Use your graph to express  $y$  in terms of  $x$ . (5)

(c) Estimate the value of  $x$  and of  $y$  for which (3)

$$xy = 4.$$

**EITHER**

12. The diagram shows a sector  $AOB$  of a circle with centre  $O$  and radius 6 cm.



- Angle  $AOB = 0.6$  radians.
- The point  $D$  lies on  $OB$  such that the length of  $OD$  is 2 cm.
- The point  $C$  lies on  $OA$  such that  $OCD$  is a right angle.

(a) Show that the length of  $OC$  is approximately 1.65 cm and find the length of  $CD$ . (4)

(b) Find the perimeter of the shaded region. (3)

(c) Find the area of the shaded region. (3)

**OR**

13. A particle moves in a straight line so that  $t$  seconds after passing a fixed point  $O$  its acceleration,  $a$   $\text{ms}^{-2}$ , is given by

$$a = 4t - 12.$$

Given that its speed at  $O$  is  $16$   $\text{ms}^{-1}$ , find

(a) the values of  $t$  at which the particle is stationary, (5)

(b) the distance the particle travels in the fifth second. (5)