

**Dr Oliver Mathematics**  
**OCR FMSQ Additional Mathematics**  
**2007 Paper**  
**2 hours**

The total number of marks available is 100.

You must write down all the stages in your working.

You are permitted to use a scientific or graphical calculator in this paper.

Final answers should be given correct to three significant figures where appropriate.

### Section A

1. Solve the inequality (3)

$$3(x + 2) > 2 - x.$$

2. A particle moves in a straight line. Its velocity,  $v \text{ ms}^{-1}$ ,  $t$  seconds after passing a point  $O$  is given by the equation (4)

$$v = 6 + 3t^2.$$

Find the distance travelled between the times  $t = 1$  and  $t = 3$ .

3. A circle has equation (3)

$$x^2 + y^2 - 4x - 6y + 3 = 0.$$

Find the coordinates of the centre and the radius of the circle.

4. Find all the values of  $x$  in the range  $0^\circ < x < 360^\circ$  that satisfy (5)

$$\sin x = -4 \cos x.$$

5. A car is travelling along a motorway at  $30 \text{ ms}^{-1}$ . At the moment that it passes a point  $A$  the brakes are applied so that the car decelerates with constant deceleration. When it reaches a point  $B$ , where  $AB = 300 \text{ m}$ , the speed of the car is  $10 \text{ ms}^{-1}$ .

Calculate

- (a) the constant deceleration, (3)  
(b) the time taken to travel from  $A$  to  $B$ . (2)
6. Find the equation of the tangent to the curve (4)

$$y = x^3 - 3x + 4$$

at the point  $(2, 6)$ .

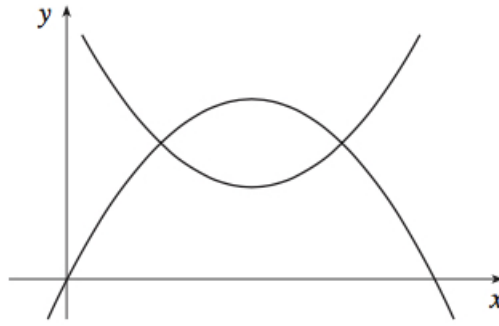
7. Use calculus to find the  $x$ -coordinate of the minimum point on the curve (7)

$$y = x^3 - 2x^2 - 15x + 30.$$

Show your working clearly, giving the reasons for your answer.

8. The figure shows the graphs of

$$y = 4x - x^2 \text{ and } y = x^2 - 4x + 6.$$



- (a) Use an algebraic method to find the  $x$ -coordinates of the points where the curves intersect. (3)
- (b) Calculate the area enclosed by the two curves. (4)
9. The points  $A$ ,  $B$ , and  $C$  have coordinates  $(-1, 1)$ ,  $(5, 8)$ , and  $(8, 3)$  respectively.
- (a) Show that  $AC = AB$ . (2)
- (b) Write down the coordinates of  $M$ , the midpoint of  $BC$ . (1)
- (c) Show that the lines  $BC$  and  $AM$  are perpendicular. (2)
- (d) Find the equation of the line  $AM$ . (2)
10. (a) By drawing suitable graphs on the same axes, indicate the region for which the following inequalities hold. You should shade the region which is **not** required. (5)

$$2x + 3y \leq 12$$

$$2x + y \leq 8$$

$$y \geq 0$$

$$x \geq 0.$$

- (b) Find the maximum value of  $x + 3y$  subject to these conditions. (2)

## Section B

11. (a) You are given that

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

- (i) Find the three points where the curve  $y = f(x)$  cuts the  $x$ -axis. (4)  
(ii) Sketch the graph of  $y = f(x)$ . (1)

- (b) You are given that

$$g(x) = x^3 - 3x^2 - 4x + 12.$$

- (i) Find the remainder when  $g(x)$  is divided by  $(x + 1)$  (2)  
(ii) Show that  $(x - 2)$  is a factor of  $g(x)$ . (1)  
(iii) Hence solve the equation  $g(x) = 0$ . (4)

12. The work-force of a large company is made up of males and females in the ratio 9 : 11. One third of the male employees work part-time and one half of the female employees work part-time.

8 employees are chosen at random.

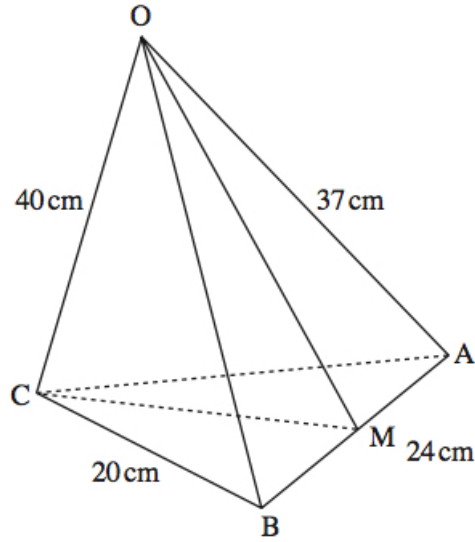
Find the probability that

- (a) all are males, (2)  
(b) exactly 5 are females, (4)  
(c) at least 2 work part-time. (6)

13. In the pyramid  $OABC$ ,

- $OA = OB = 37$  cm,
- $OC = 40$  cm,
- $CA = CB = 20$  cm, and
- $AB = 24$  cm

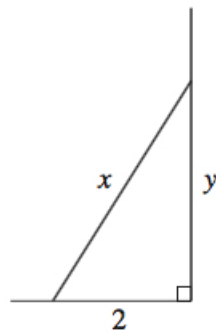
$M$  is the midpoint of  $AB$ .



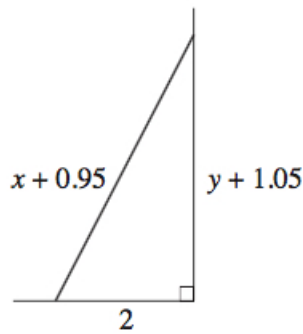
Calculate

- (a) the lengths  $OM$  and  $CM$ , (3)
- (b) the angle between the line  $OC$  and the plane  $ABC$ , (4)
- (c) the volume of the pyramid. (5)

14. An extending ladder has two positions. In position  $A$ , the length of the ladder is  $x$  metres and, when the foot of the ladder is placed 2 metres from the base of a vertical wall, the ladder reaches  $y$  metres up the wall.



**Position A**



**Position B**

In position  $B$ , the ladder is extended by 0.95 metres and it reaches an extra 1.05 metres up the wall.

The foot of the ladder remains 2 m from the base of the wall.

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(a) Use Pythagoras' theorem for position  $A$  and position  $B$  to write down two equations in  $x$  and  $y$ . (2)

(b) Hence show that (3)

$$2.1y = 1.9x - 0.2.$$

(c) Using these equations, form a quadratic equation in  $x$ . (7)  
Hence find the values of  $x$  and  $y$ .

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