RECOGNISING ACHIEVEMENT

FREE-STANDING MATHEMATICS QUALIFICATION
Advanced Level

ADDITIONAL MATHEMATICS 6993/01

THURSDAY 14 JUNE 2007

Afternoon
Time: 2 hours

Additional materials:
Answer booklet (16 pages)
Graph paper

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- 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.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 100.

ADVICE TO CANDIDATES

- Read each question carefully and make sure you know what you have to do before starting your answer.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **7** printed pages and **1** blank page.

Section A

1 Solve the inequality $3(x+2) > 2 - x$. [3]

2 A particle moves in a straight line. Its velocity, $v\,\mathrm{m\,s^{-1}}$, t seconds after passing a point O is given by the equation

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

Find the distance travelled between the times $t = 1$ and $t = 3$. [4]

3 A circle has equation $x^2 + y^2 - 4x - 6y + 3 = 0$.

Find the coordinates of the centre and the radius of the circle. [3]

4 Find all the values of x in the range $0° < x < 360°$ that satisfy $\sin x = -4\cos x$. [5]

5 A car is travelling along a motorway at $30\,\mathrm{m\,s^{-1}}$. 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 m, the speed of the car is $10\,\mathrm{m\,s^{-1}}$.

Calculate

(i) the constant deceleration, [3]

(ii) the time taken to travel from A to B. [2]

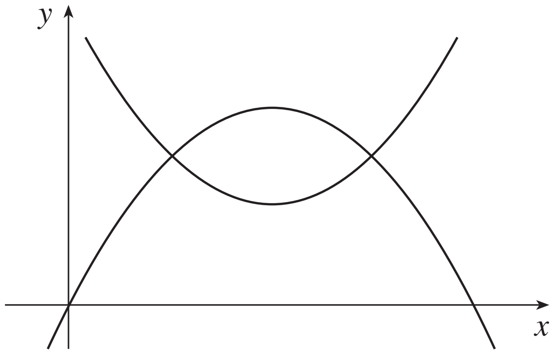
6 Find the equation of the tangent to the curve $y = x^3 - 3x + 4$ at the point $(2, 6)$. [4]

7 Use calculus to find the x-coordinate of the minimum point on the curve

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

Show your working clearly, giving the reasons for your answer. [7]

8 The figure shows the graphs of $y = 4x - x^2$ and $y = x^2 - 4x + 6$.



(i) Use an algebraic method to find the x-coordinates of the points where the curves intersect. [3]

(ii) 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.

(i) Show that AC = AB. [2]

(ii) Write down the coordinates of M, the midpoint of BC. [1]

(iii) Show that the lines BC and AM are perpendicular. [2]

(iv) Find the equation of the line AM. [2]

10 **(i)** 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.

$$\begin{aligned} 2x + 3y &\leqslant 12 \\ 2x + y &\leqslant 8 \\ y &\geqslant 0 \\ x &\geqslant 0 \end{aligned}$$

[5]

(ii) 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.

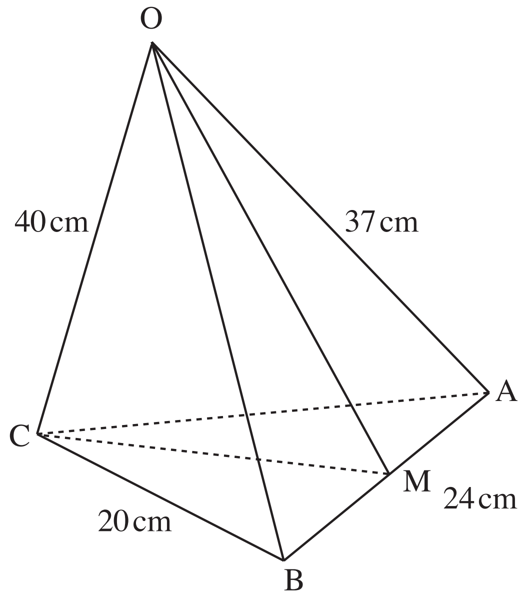
Find the probability that

(i) all are males, [2]

(ii) exactly 5 are females, [4]

(iii) 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

(i) the lengths OM and CM, [3]

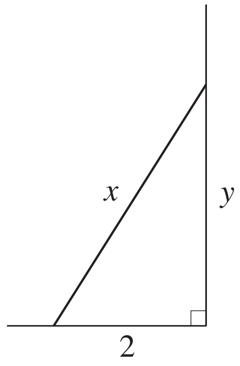
(ii) the angle between the line OC and the plane ABC, [4]

(iii) the volume of the pyramid. [5]

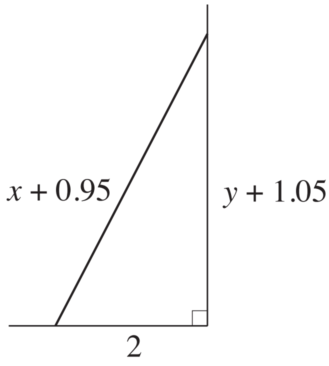
[The volume of a pyramid $= \frac{1}{3} \times$ base area $\times$ height.]

[Question 14 is printed overleaf.]

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.

(i) Use Pythagoras' theorem for position **A** and position **B** to write down two equations in x and y. [2]

(ii) Hence show that $2.1y = 1.9x - 0.2$. [3]

(iii) Using these equations, form a quadratic equation in x.

Hence find the values of x and y. [7]

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