OCR
RECOGNISING ACHIEVEMENT

FREE-STANDING MATHEMATICS QUALIFICATION
ADVANCED LEVEL

ADDITIONAL MATHEMATICS **6993**

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 16 page Answer Booklet
- Graph paper

Other Materials Required:
None

Friday 5 June 2009
Afternoon

Duration: 2 hours

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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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

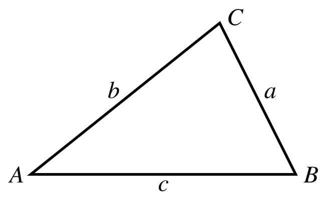
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **100**.
- This document consists of **8** pages. Any blank pages are indicated.

3R–8K18
Turn over

Formulae Sheet: 6993 Additional Mathematics

In any triangle *ABC*

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$



Binomial expansion

When n is a positive integer

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n$$

where

$$\binom{n}{r} = {}^nC_r = \frac{n!}{r!(n-r)!}$$

Section A

1 The angle θ is greater than 90° and less than 360° and $\cos\theta = \frac{2}{3}$. Find the exact value of $\tan\theta$. **[3]**

2 Find the equation of the normal to the curve $y = x^3 + 5x - 7$ at the point $(1, -1)$. **[5]**

3 A is the point (1, 5) and C is the point (3, p).

(i) Find the equation of the line through A which is parallel to the line $2x + 5y = 7$. **[2]**

(ii) This line also passes through the point C. Find the value of p. **[2]**

4 AB is a diameter of a circle, where A is (1, 1) and B is (5, 3).

Find

(i) the exact length of AB, **[2]**

(ii) the coordinates of the midpoint of AB, **[1]**

(iii) the equation of the circle. **[3]**

5 Parcels slide down a ramp. Due to resistance the deceleration is $0.25\,\text{m}\,\text{s}^{-2}$.

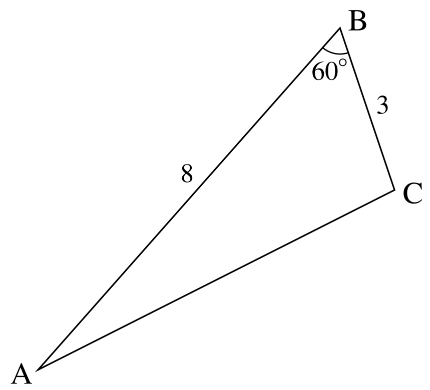
(i) One parcel is given an initial velocity of $2\,\text{m}\,\text{s}^{-1}$. Find the distance travelled before the parcel comes to rest. **[3]**

(ii) A second parcel is given an initial velocity of $3\,\text{m}\,\text{s}^{-1}$ and takes 4 seconds to reach the bottom of the ramp. Find the length of the ramp. **[3]**

6 The gradient function of a curve is given by $\frac{dy}{dx} = 1 - 4x + 3x^2$.

Find the equation of the curve given that it passes through the point (2, 6). **[4]**

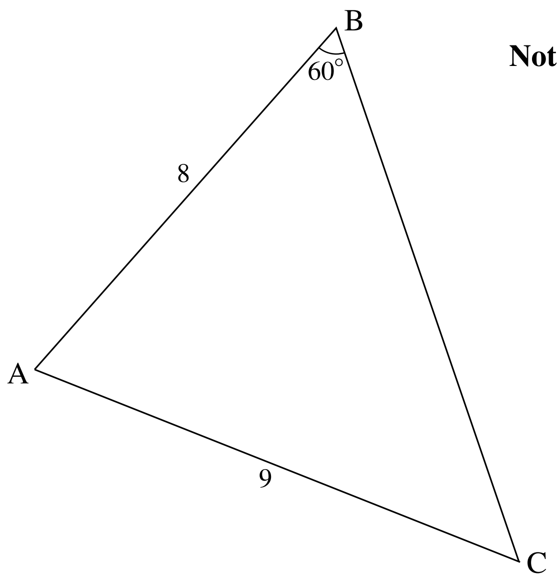
7 The course of a cross-country race is in the shape of a triangle ABC.
AB = 8 km, BC = 3 km and angle ABC = $60°$.



Not to scale

(i) Calculate the distance AC and hence the total length of the course. **[4]**

(ii) The organisers extend the course so that AC = 9 km.



Not to scale

Calculate the angle BCA. **[3]**

8 Calculate the x-coordinates of the points of intersection of the line $y = 2x + 11$ and the curve $y = x^2 - x + 5$. Give your answers correct to 2 decimal places. **[5]**

9 A car accelerates from rest. At time t seconds, its acceleration is given by $a = 4 - 0.2t \text{ m s}^{-2}$ until $t = 20$.

(i) Find the velocity after 5 seconds. **[3]**

(ii) What is happening to the velocity at $t = 20$? **[1]**

(iii) Find the distance travelled in the first 20 seconds. **[3]**

10 **(i)** Illustrate on one graph the following three inequalities.

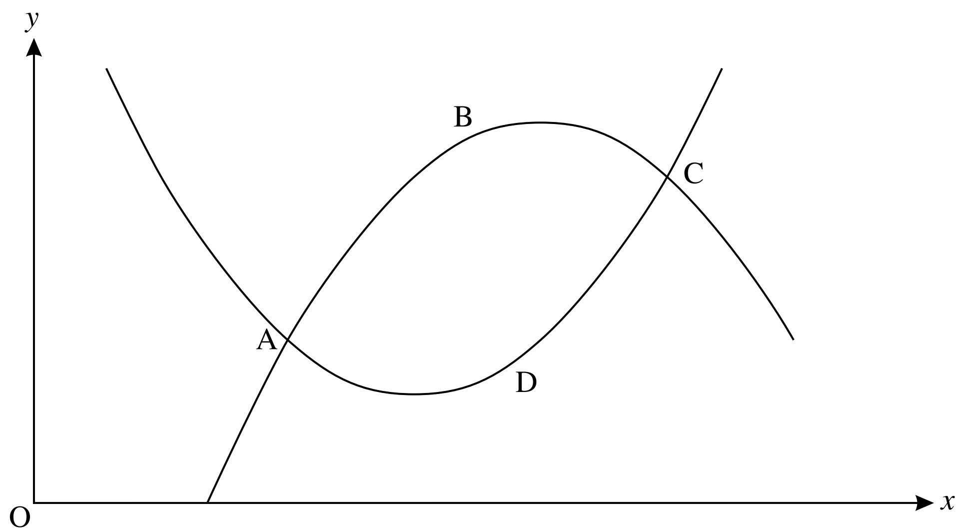
$$y \geqslant x - 1$$
$$x \geqslant 2$$
$$2x + y \geqslant 8$$

Draw suitable boundaries and shade areas that are **excluded**. **[4]**

(ii) Write down the minimum value of y in this region. **[1]**

Section B

11 The shape ABCD below represents a leaf.
The curve ABC has equation $y = -x^2 + 8x - 9$.
The curve ADC has equation $y = x^2 - 6x + 11$.

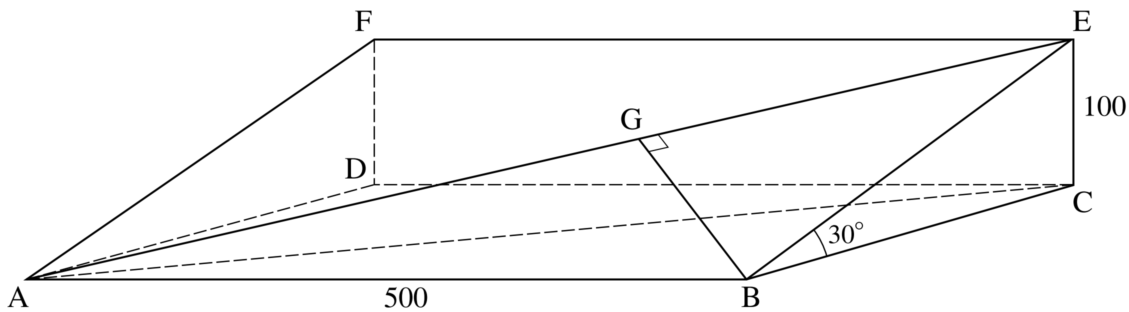


(i) Find algebraically the coordinates of A and C, the points where the curves intersect. **[5]**

(ii) Find the area of the leaf. **[7]**

12 The diagram shows a rectangle ABEF on a plane hillside which slopes at an angle of 30° to the horizontal. ABCD is a horizontal rectangle. E and F are 100 m vertically above C and D respectively. AB = DC = FE = 500 m.

AE is a straight path.
From B there is a straight path which runs at right angles to AE, meeting it at G.



(i) Find the distance BE. **[3]**

(ii) Find the angle that the path AE makes with the horizontal. **[4]**

(iii) Find the area of the triangle ABE.

Hence find the length BG. **[5]**

13 In a supermarket chain there are a large number of employees, of whom 40% are male.

(a) One employee is chosen to undergo training.
What assumption is made if 0.4 is taken to be the probability that this employee is male? **[1]**

(b) 6 employees are chosen at random to undergo training.

(i) Show that P(all 6 chosen are female) = 0.0467, correct to 4 decimal places. **[2]**

Find the probability that

(ii) 3 are male and 3 are female, **[4]**

(iii) there are more females than males chosen. **[5]**

14 **(a)** **(i)** On the same graph, draw sketches of the curve $y = x^3$ and the line $y = 3 - 2x$. **[2]**

(ii) Use your sketch to explain why the equation $x^3 + 2x - 3 = 0$ has only one root. **[1]**

(b) **(i)** Show by differentiation that there are no stationary points on the curve $y = x^3 + 3x - 4$. **[3]**

(ii) Hence explain why the equation $x^3 + 3x - 4 = 0$ has only one root. **[1]**

(c) **(i)** Use the factor theorem to find an integer root of the equation $x^3 + x - 10 = 0$. **[1]**

(ii) Write the equation $x^3 + x - 10 = 0$ in the form $(x - a)(x^2 + px + q) = 0$ where a, p and q are values to be determined. **[2]**

(iii) By considering the quadratic equation $x^2 + px + q = 0$ found in part **(ii)**, show that the cubic equation $x^3 + x - 10 = 0$ has only one root. **[1]**

(d) You are given that r and s are positive numbers. What do the results in parts **(a)**, **(b)** and **(c)** suggest about the equation $x^3 + rx - s = 0$? **[1]**