OCR
RECOGNISING ACHIEVEMENT

Thursday 23 May 2013 – Afternoon

LEVEL 3 CERTIFICATE
ENGINEERING

H865/01 Mathematical Techniques and Applications for Engineers
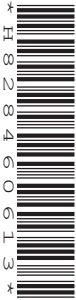
Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
• Scientific calculator

Duration: 2 hours

Candidate forename		Candidate surname	

Centre number						Candidate number					

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. HB pencil may be used for graphs and diagrams only.
* Answer **all** the questions in **Section A** and any **three** questions from **Section B**.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Do **not** write in the bar codes.

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 **60**.
* This document consists of **16** pages. Any blank pages are indicated.

A scientific calculator may be used for this paper

OCR is an exempt Charity

Turn over
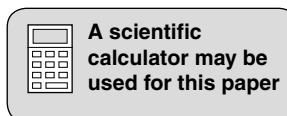
SECTION A

Answer **all** questions in the spaces provided.

1   Remove the brackets and simplify $2(3x + 4) - 5x$.

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   .... **[2]**

2   Factorise the expression $x^2 + 5x + 6$.

   ....

   .... **[2]**

3   Simplify the expression $(x + 8)/2 - (x + 6)/5$.

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   .... **[2]**

4   Solve the equation $(-3x - 4)/5 = (2x + 6)/10$.

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   .... **[2]**

5   Calculate the angle, in degrees, of a sector subtended at the centre of a circle of diameter 400 mm by an arc of length 800 mm.

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   .... **[2]**

6   In a right-angled triangle ABC, length AC = 2.5 m, angle A = 60° and B is the right angle. Calculate length AB.

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   .... **[2]**

7 If $\tan \theta = 1/x$ and θ is an acute angle, find $\sin \theta$ in terms of x.

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.... **[2]**

8 The sides of a triangle ABC are length a = 6 m, length b = 8 m and length c = 10 m.

Calculate the area of the triangle.

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.... **[2]**

9 Differentiate $y = 2x^3 + \cos x$ with respect to x.

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.... **[2]**

10 Differentiate $y = \sin x + 5 \ln (3x)$ with respect to x.

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.... **[2]**

11 Integrate $\sin (2x)$ with respect to x.

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.... **[2]**

12 Calculate the value of the definite integral $\int_{1}^{2} 5x^4 \; dx$.

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.... **[2]**

Turn over

13 The frequency table shown below has two values missing.

Complete the table if the range of x is 7 and Σf = 20.

x	1	3	4	6	8
f	2	4	6	5	3

[2]

14 Draw a distribution curve with a negative skew in the space below.

[2]

15 Three hundred packages are posted on one day. The probability that a package is delivered within 24 hours of posting is 0.8. If the probability of the delivered packages are independent:

Determine how many packages you would expect to be delivered within 24 hours.

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.... [2]

SECTION B

Answer any **three** questions in the spaces provided.

1 **(a)** Given that $\tan \alpha = np/(\pi d)$.

Calculate the angle α when n = 2, p = 6 and d = 72.

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.... **[4]**

(b) **(i)** Transpose the formula $\tan \alpha = np/(\pi d)$ to make d the subject.

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.... **[2]**

(ii) Calculate the value of d when α = 6, n = 4 and p = 12.

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.... **[2]**

(c) The velocity ratio V of a hydraulic ram is given by $V = (D/d)^2$.

Transpose the formula to make d the subject.

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.... **[2]**

[Total: 10]

Turn over

2 In a workshop:
ten type A machines and four type B machines can make a total of 450 components per week;
eight type A machines and two type B machines can make a total of 270 components per week.

(a) Write down **two** simultaneous equations from the given information.

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.... **[2]**

(b) Use the simultaneous equations to determine how many components can be made by the type A machine in a week.

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.... **[3]**

(c) Determine how many components can be made by the type B machine in a week.

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.... **[4]**

(d) Show a suitable check to confirm that the values you have found in parts **(b)** and **(c)** are correct.

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.... **[1]**

[Total: 10]

3 In a triangle ABC, angle B = 50°, length a = 6 m and length c = 8 m.

(a) Calculate length b.

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.... **[5]**

(b) Calculate acute angle C.

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.... **[4]**

(c) Calculate angle A.

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.... **[1]**

[Total: 10]

4 **(a)** Draw a diagram of the situation described in the space below.

Points A, B and C are in a horizontal straight line.
Points A and B are 100 metres apart.
At point C there is a vertical mast CD.
The angles of elevation to the top of the mast point D, from point A is 30° and from point B is 48°.

[2]

(b) Calculate the length CB.

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.... **[5]**

(c) Calculate the height of the mast CD.

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.... **[3]**

[Total: 10]

5 **(a)** Determine the gradients of the curve $y = x^3 + 2x$ at the points where $x = -2$ and $x = +2$.

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.... **[3]**

(b) The length L metres of a metal rod at temperature $t\,°C$ is given by $L = 1 + 0.0003t + 0.0000003t^2$. Determine the rate of change of length when the temperature is $200\,°C$.

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.... **[3]**

(c) The pressure P of the atmosphere at height h above ground level is given by $P = P_o e^{-h/C}$ where P_o is the pressure at ground level and C is a constant.

Determine the rate of change of pressure with the height when $P_o = 10^6$ pascal, height $h = 2000$ metre and $C = 5 \times 10^4$.

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.... **[4]**

[Total: 10]

6 **(a)** Complete the table for the equation $y = 2x^2 + 3$ from $x = -3$ to $x = +3$.

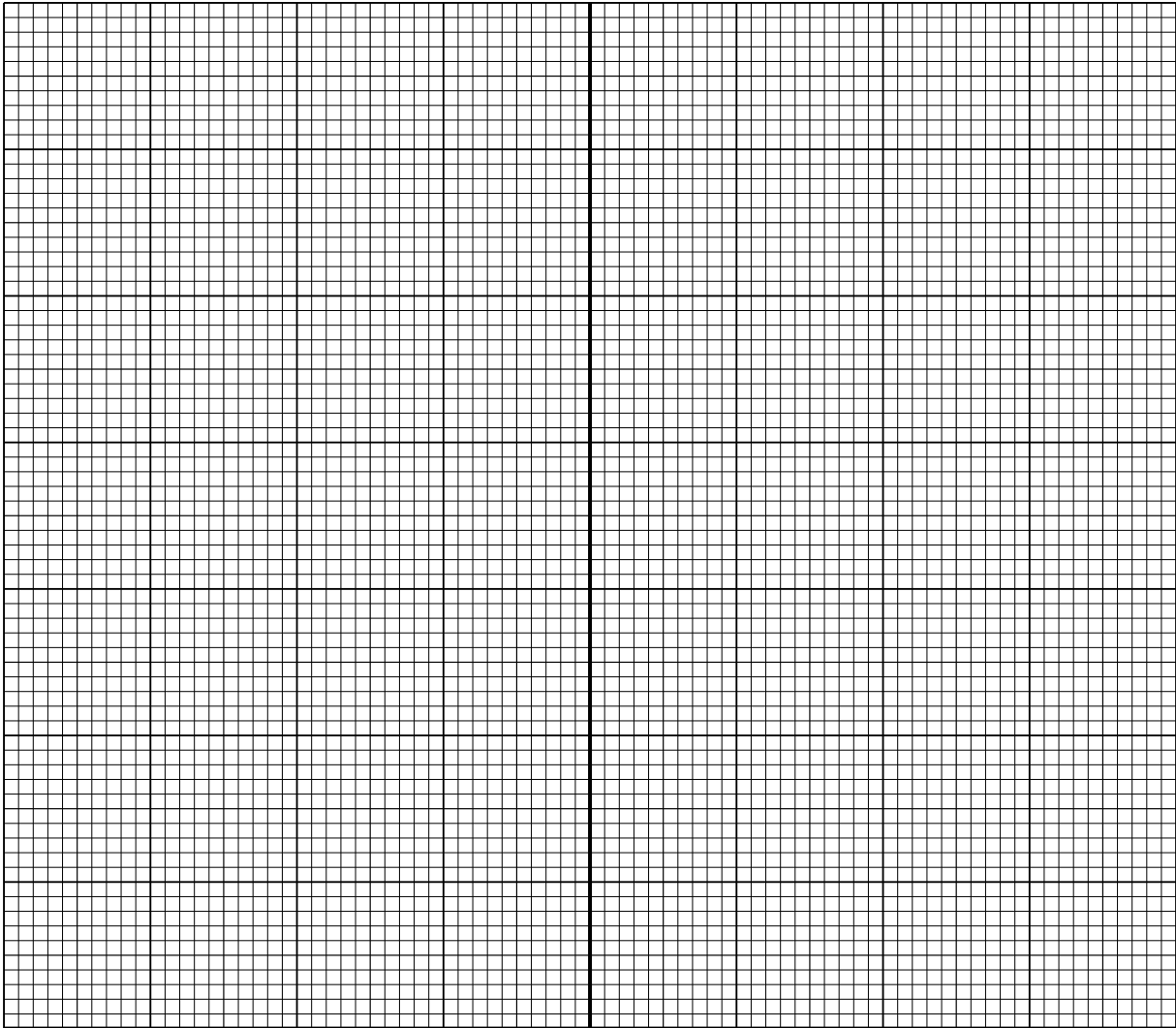| x	−3	−2	−1	0	1	2	3
y							

[1]

(b) Fig. 1 shows a pair of axes.

Fig. 1

Using the values from the completed table draw a graph, on Fig. 1 of $y = 2x^3 + 3$ from $x = -3$ to $x = +3$. [3]

(c) Determine by integration the area enclosed by the curve, the x-axis and the ordinates x = –2 and x = +2

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.... **[6]**

[Total: 10]

Turn over

7 (a) Explain what is meant by the term:

(i) Cumulative frequency

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(ii) Mode

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(iii) Median

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(iv) Mean

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[4]

(b) Fig. 2 shows a cumulative frequency curve.
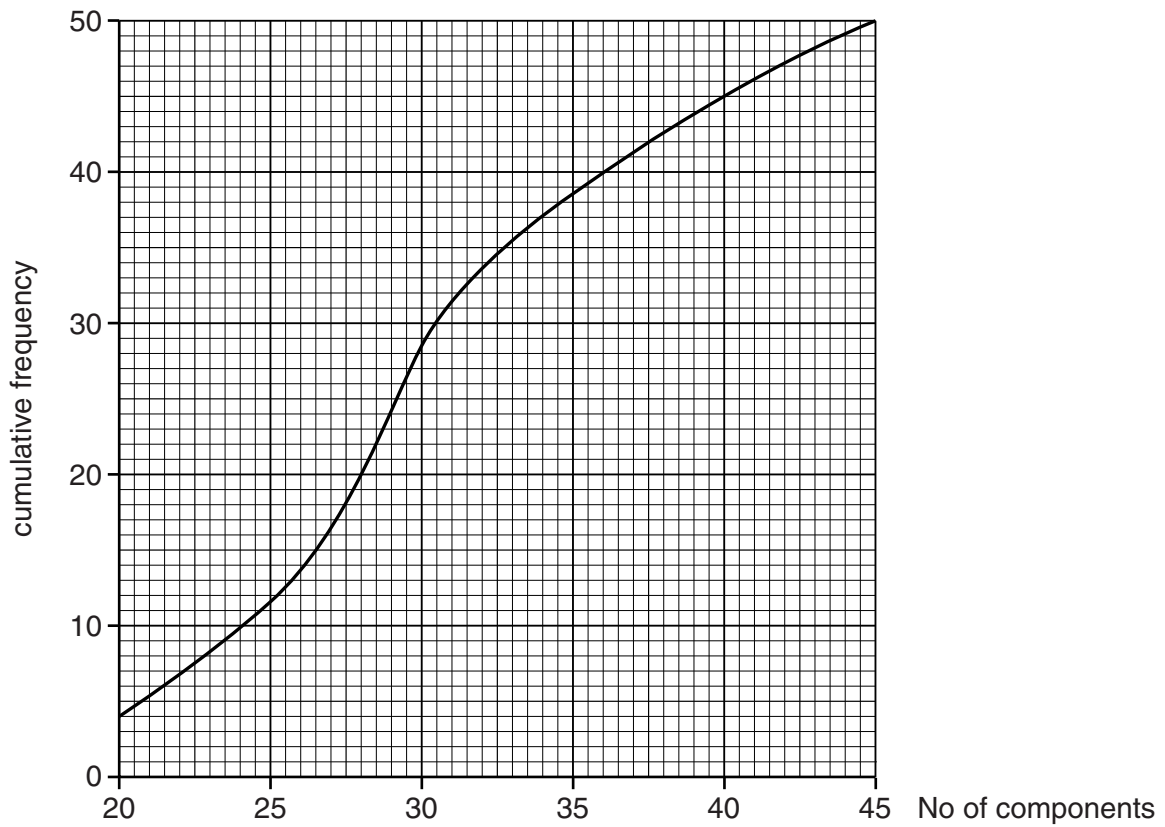
Fig. 2

Estimate the value of the:

(i) lower quartile

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(ii) median

....

(iii) upper quartile

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[3]

(c) Estimate the number of components at the:

(i) lower quartile

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(ii) median

....

(iii) upper quartile

....
[3]

[Total: 10]

Turn over

8 A survey was carried out with a group of 255 people. The results show that 165 own a laptop, 215 own a mobile phone and 125 own both.

(a) (i) Show that all people in the survey own either a laptop or a mobile phone.

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.... **[3]**

(ii) Determine the probability that a person chosen at random from the sample owns a laptop or mobile phone but not both.

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.... **[2]**

(b) A person owns a mobile phone. Determine the probability that they also own a laptop.

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.... **[3]**

(c) A person owns a laptop. Determine the probability that they **do not** own a mobile phone.

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.... **[2]**

[Total: 10]

END OF QUESTION PAPER

15

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