

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**

SECTION A

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

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

.....
..... [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]

3

- 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.

.....

.....

..... [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 .

.....

.....

..... [2]

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

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..... [2]

- 12 Calculate the value of the definite integral $\int_1^2 5x^4 \, dx$.

.....

.....

..... [2]

4

- 13** The frequency table shown below has two values missing.

Complete the table if the range of x is 7 and $\Sigma f = 20$.

x	1	3	4	6	
f	2	4	6		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.

.....

..... [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.

.....

.....

..... [2]

- (ii) Calculate the value of d when $\alpha = 6$, $n = 4$ and $p = 12$.

.....

.....

..... [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.

.....

.....

.....

..... [2]

[Total: 10]

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.

.....

 [2]

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

.....

 [3]

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

.....

 [4]

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

.....

 [1]

[Total: 10]

7

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 $x = +2$.

.....
 [3]

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

.....

 [3]

- (c) The pressure P of the atmosphere at height h above ground level is given by $P = P_0 e^{-h/C}$ where P_0 is the pressure at ground level and C is a constant.

Determine the rate of change of pressure with the height when $P_0 = 10^6$ pascal, height $h = 2000$ metre and $C = 5 \times 10^4$.

.....

 [4]

[Total: 10]

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.

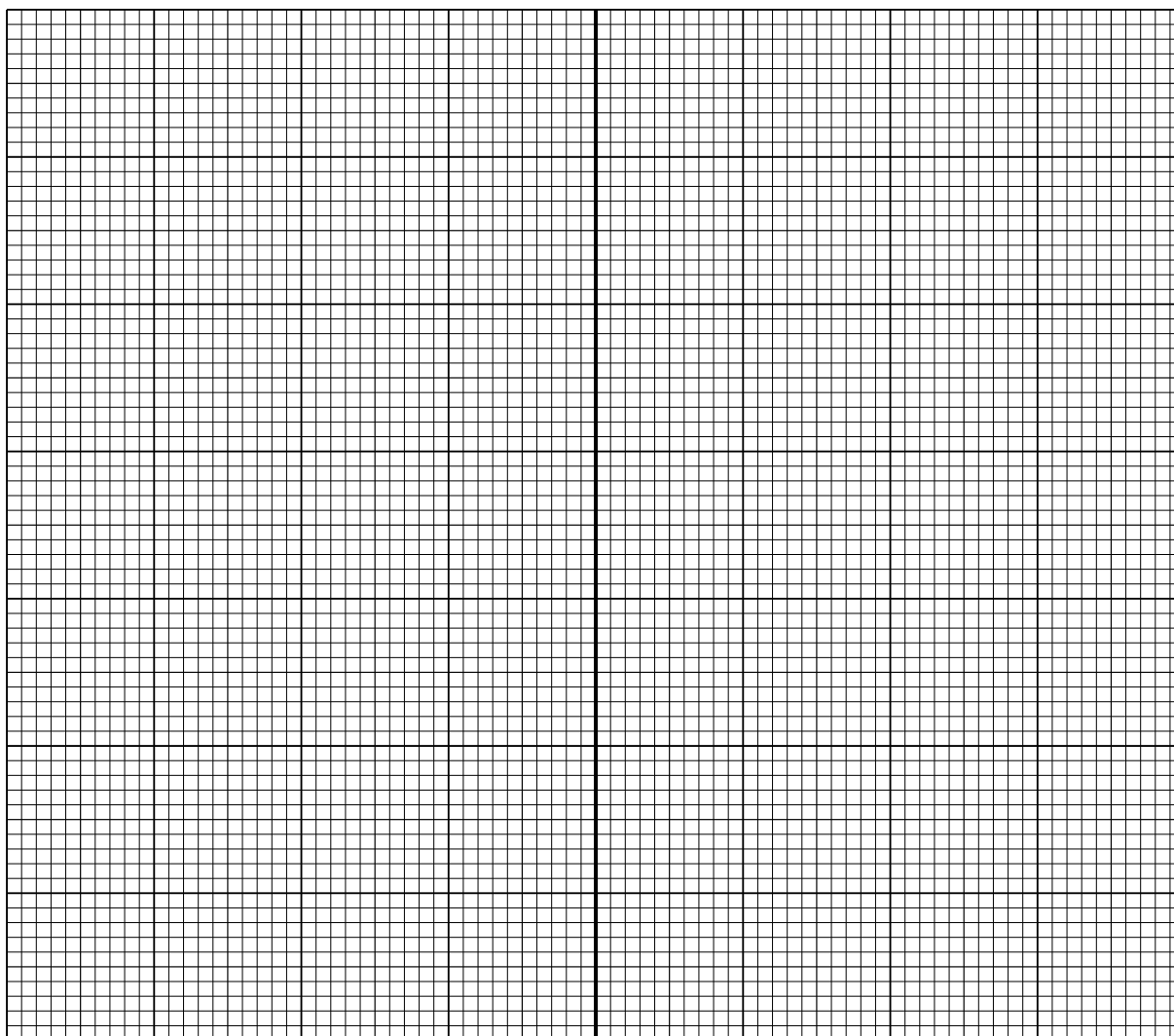


Fig. 1

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

[3]

11

- (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]

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

.....

.....

[4]

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

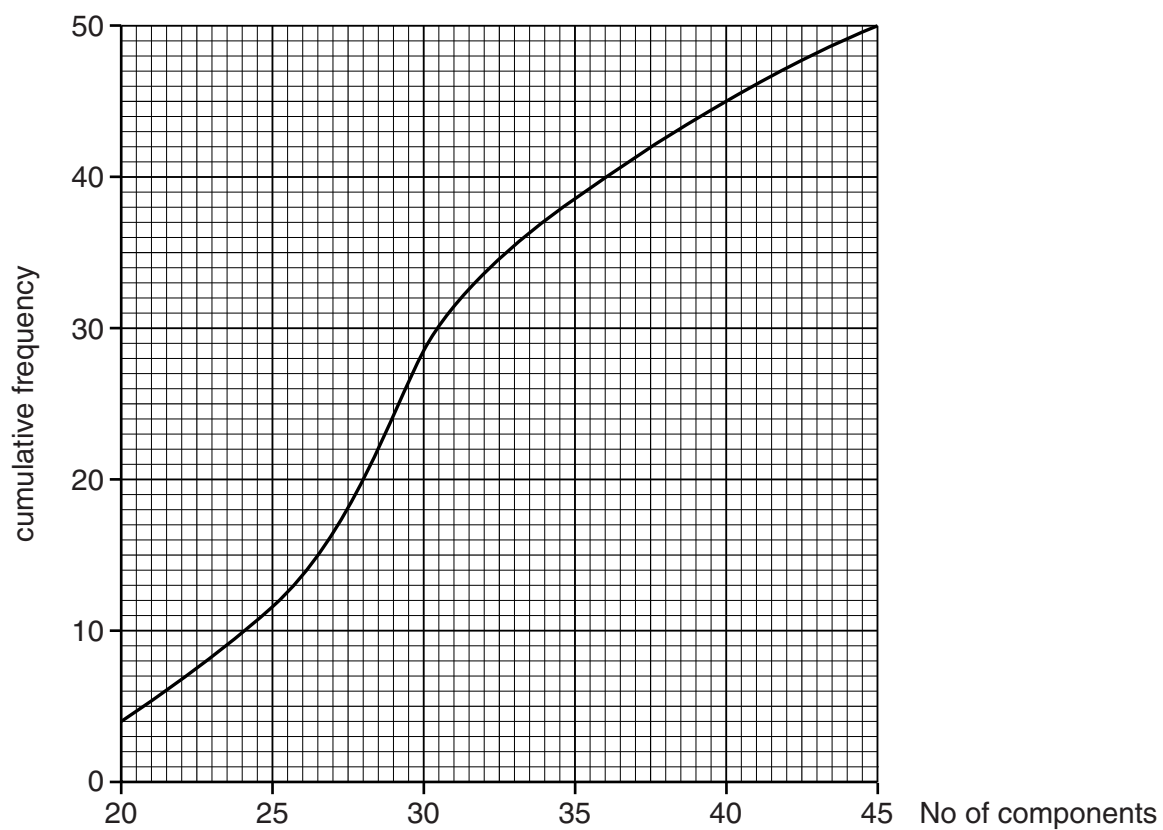


Fig. 2

13

Estimate the value of the:

(i) lower quartile

.....

(ii) median

.....

(iii) upper quartile

.....

[3]

(c) Estimate the number of components at the:

(i) lower quartile

.....

(ii) median

.....

(iii) upper quartile

.....

[3]

[Total: 10]

- 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

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