

SPECIMEN PAPER

UNIT 8 - MATHEMATICAL TECHNIQUES AND APPLICATIONS FOR ENGINEERS



Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



Level 3 Diploma Principal Learning
Specimen Paper

Engineering

ENG3U8

Unit 8 Mathematical techniques and applications for engineers

Date Time

For this paper you must have:

- normal writing and drawing instruments and a calculator.

Time allowed

- 2 hours and 30 minutes

Instructions

- Use black ink or black ball-point pen. Use pencil only for drawing.
- Answer **all** questions in Section A and three out of five questions in Section B.
- You must answer questions in the spaces provided. Answers written in margins or on blank pages will not be marked.

Information

- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- Show the rough working of your calculations.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
TOTAL	



Barcode

ENG3U8

SECTION AAnswer **all** questions in this section.

1

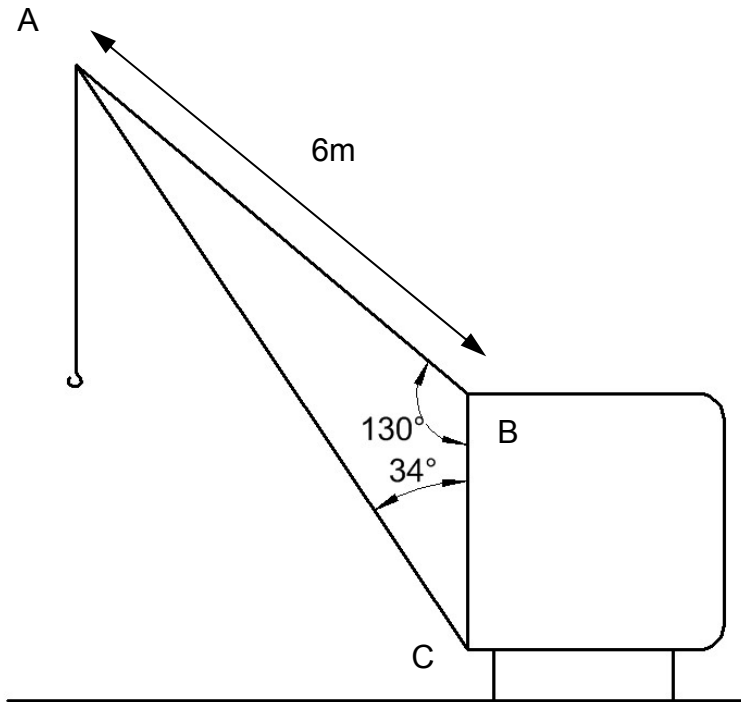
Figure 1

Figure 1 shows the general arrangement of a jib crane. Find the length of the jib AC.

.....

.....

.....

.....

.....

.....

(3 marks)

- 2 The drum on a crane's winch turns through 24 radians whilst raising a load in a steel smelting plant. How many degrees is this?

.....
.....
.....
.....

(2 marks)

- 3 A car has to be positioned on a production line on the following vector co-ordinates, one after the other. What is the car's distance from its starting position (the magnitude of the sum of the vectors)?

$$u = 2i + 3j$$

$$v = 3i - 5j$$

.....
.....
.....
.....

(2 marks)

- 4 The distance s travelled by an object undergoing uniform acceleration is given by:

$$s = v_i t + \frac{1}{2} a t^2$$

Make acceleration a the subject of the equation.

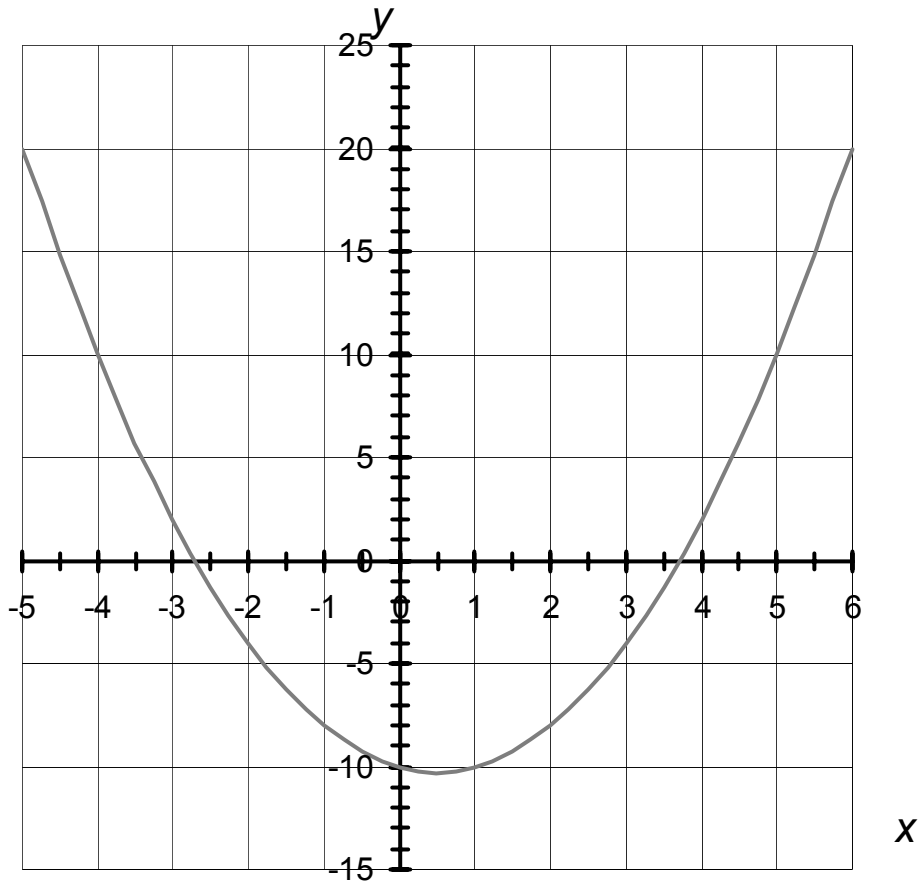
.....
.....
.....
.....

(2 marks)

Turn over ►

- 5 Plot the equation $y = x + 2$ on the graph below and find the solution to the following simultaneous equations:

$$y = x^2 - x - 10 \text{ and } y = x + 2$$



.....

.....

.....

.....

.....

.....

(3 marks)

- 6 Convert the following polar coordinate to Cartesian coordinates $(4, 127^\circ)$.

.....
.....
.....
.....

(2 marks)

- 7 Factorise the following quadratic equation and find its two solutions.

$$0 = 9x^2 - 16$$

.....
.....
.....
.....
.....
.....
.....
.....

(4 marks)

- 8 Using the rules of indices simplify the following, expressing your answer as a single power of a .

$$\frac{a^{-3/4}}{a^{-5/2}}$$

.....

.....

.....

.....

.....

.....

(3 marks)

- 9 Samples of 38 electrical components were found to have the following resistance values. What is the average resistance of the component sample?

Resistance ($k\Omega$)	8.8	9.1	9.4	9.5	9.8	10	10.3
Frequency	2	4	8	9	7	5	3

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

- 10 A rollercoaster distance s (m) with respect to time t (seconds) is given by:

$$s = 3t^3 - 10t^2 + 10t + 8$$

What is the acceleration of the cyclist after 3 seconds?

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

- 11 A quadratic curve is given by the equation:

$$y = 3x^2 - 12x + 4$$

By taking the first derivative and equating to zero show that $x = 2$ when y is at its lowest value.

.....

.....

.....

.....

.....

.....

(3 marks)

Turn over ►

12 Write down the indefinite integral of the equation below.

$$3x^2 + 2x - 3$$

.....

.....

.....

.....

.....

.....

.....

.....

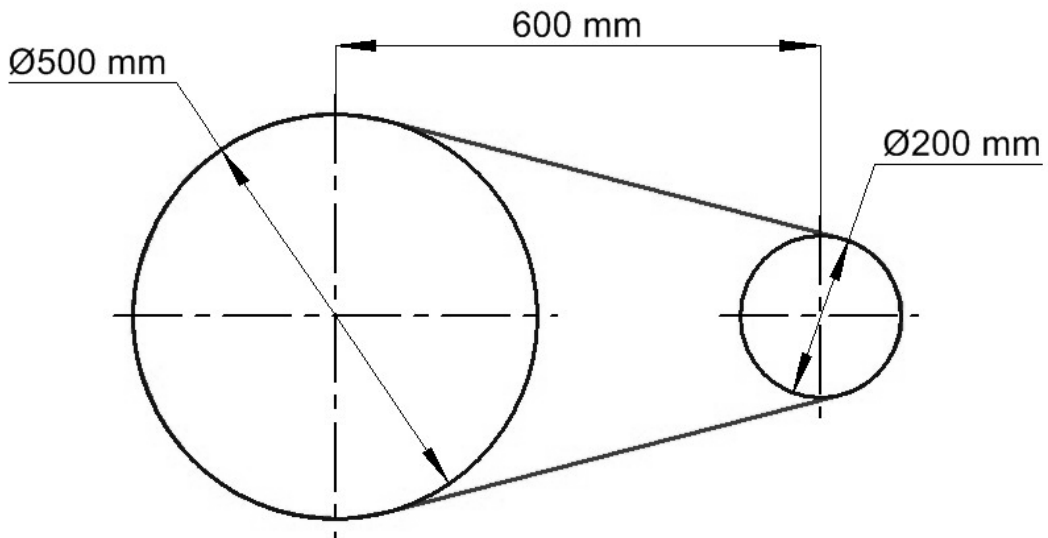
(4 marks)

Turn over for the next question

SECTION B

Answer any **three** questions.

13



The diagram shows the arrangement of two pulleys and a connecting belt. What is the length of the belt?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

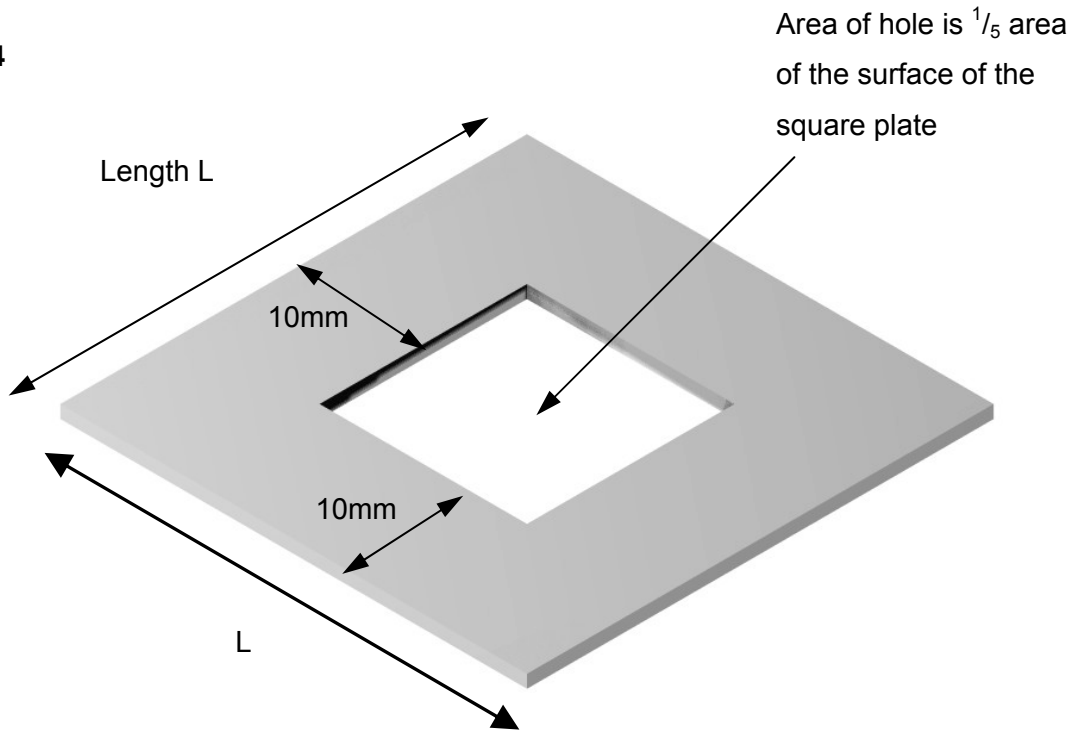
.....

.....

(8 marks)

Turn over ►

14



A square hole is to be cut into a square plate to give a 10mm margin in such a way that the hole is $\frac{1}{5}$ the area of the original square plate. Calculate the length L of the side of the plate.

.....

.....

.....

.....

.....

.....

.....

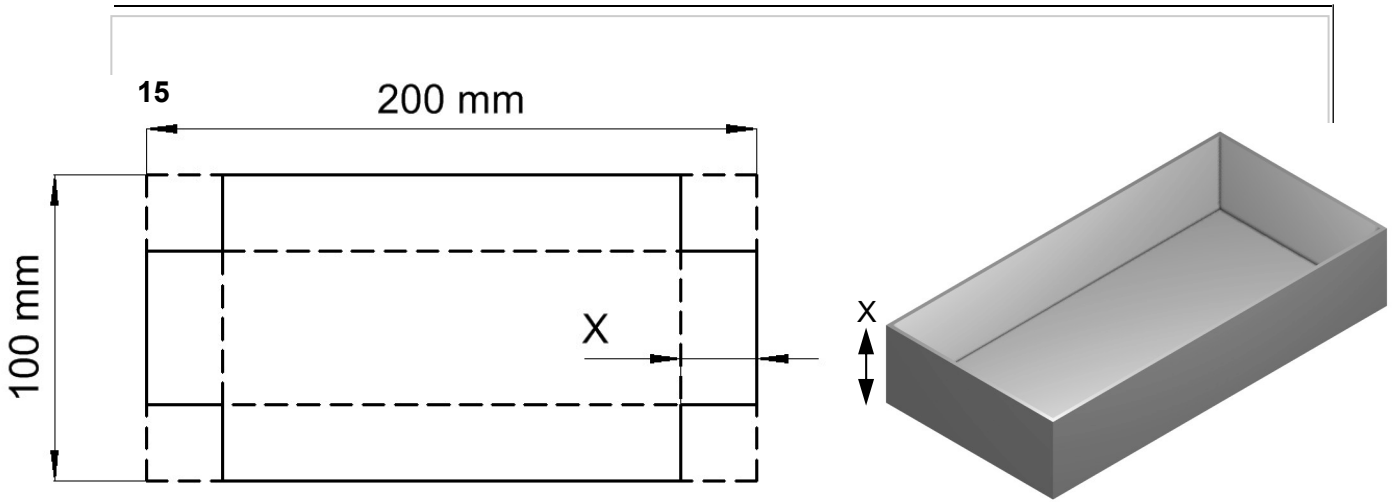
.....

.....

.....

.....

(8 marks)



A box is to be made by folding in the sides of a rectangular sheet. The sheet is 200mm x 100mm. For the box to achieve maximum volume, what would its height be?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(8 marks)

