

Student Name: \_\_\_\_\_

Student ID No: \_\_\_\_\_

**CORK INSTITUTE OF TECHNOLOGY**

**AUGUST/REPEAT EXAMINATIONS 2017/2018**

**MODULE:** MATH6058 - Engineering Mathematics 1 (Apprenticeship)

**PROGRAMME(S):**  
HIGHER CERTIFICATE IN ENGINEERING IN  
MANUFACTURING ENGINEERING  
BACHELOR OF ENGINEERING IN MANUFACTURING  
ENGINEERING

**YEAR OF STUDY:** 1

**EXAMINER(S):**  
MS GRAINNE READ (Internal)  
DR JAMES CRUICKSHANK (External)

**TIME ALLOWED:** 2 Hours

**INSTRUCTIONS:** Answer 4 questions. All questions carry equal marks.

Q1	
Q2	
Q3	
Q4	
Q5	
Score	

**PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.**

The use of programmable or text storing calculators is expressly forbidden.

Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

*Requirements for this paper:*

**1. Log Tables**

**QUESTION 1 ALGEBRA & FUNCTIONS**

**[TOTAL MARKS: 25]**

**Q 1(a)**

**[10 Marks]**

The frequency  $f$  Hertz, of a circuit is given by the formula

$$f = \frac{1}{2\pi\sqrt{LC}}$$

- (i) Evaluate  $f$  correct to 3 significant figures for  $L = 0.005$  henry and  $C = 0.000001$  farad.

- (ii) Transpose the formula to make  $C$  the subject of the formula.

**Q 1(b)****[15 Marks]**

A missile is launched and follows a path given by the function

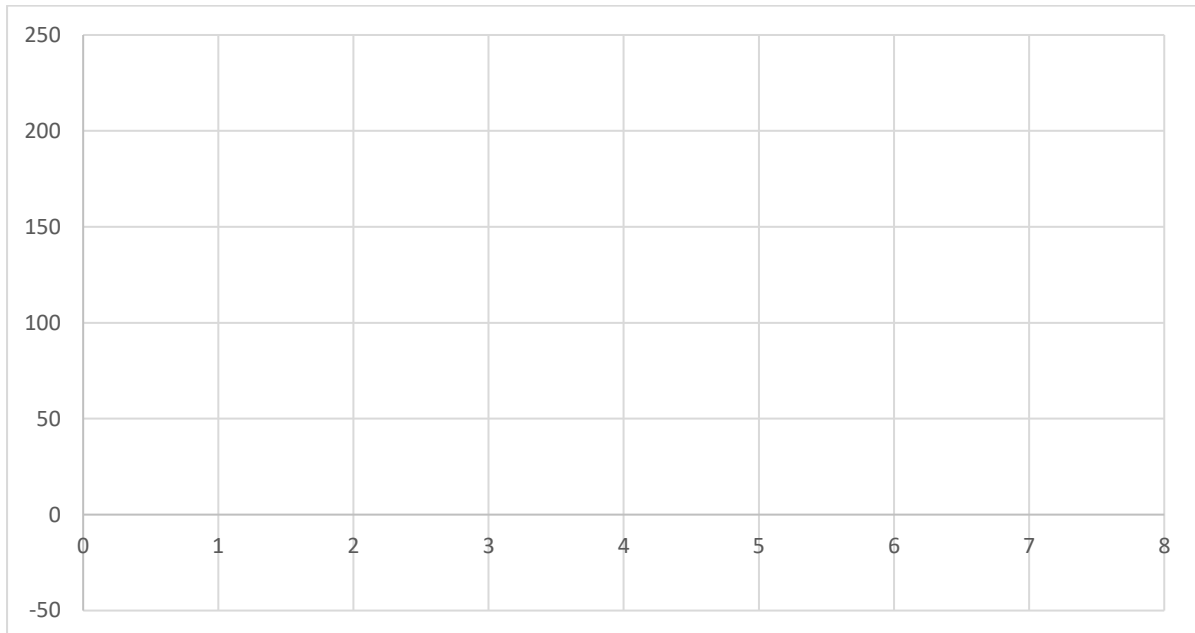
$$h(t) = 50 + 100t - 16t^2$$

Where  $t$  is the time in seconds after launch and  $h$  is the height of the missile after a time  $t$ .

- (i) Complete the following table to show the height of the missile during it's flight.

Time (t)	0	1	2	3	4	5	6	7
Height (h)								

- (ii) Draw the graph of the function in the space provided below remembering to label the axes.



- (iii) From your graph find the maximum height reached by the missile

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***[End of Question1]***

**QUESTION 2 MATRICES**

**[TOTAL MARKS: 25]**

**Q 2(a)**

**[15 Marks]**

For the matrices  $A = \begin{pmatrix} 2 & 3 \\ 1 & -4 \end{pmatrix}$  and  $B = \begin{pmatrix} -5 & 7 \\ -3 & 4 \end{pmatrix}$  find:

(i)  $A + B$

(ii)  $A \times B$

(iii)  $B \times A$

(iv)  $A^{-1}$

**Q 2(b)**

**[10 Marks]**

Using your answer to part (a) (iv) solve the following system of linear equations for  $x$  and  $y$ :

$$2x + 3y = 4$$

$$x - 4y = -3$$

(Write the equations in Matrix form, and use matrix inversion to solve)

***[End of Question2]***

**QUESTION 3 COMPLEX NUMBERS & VECTORS**

**[TOTAL MARKS: 25]**

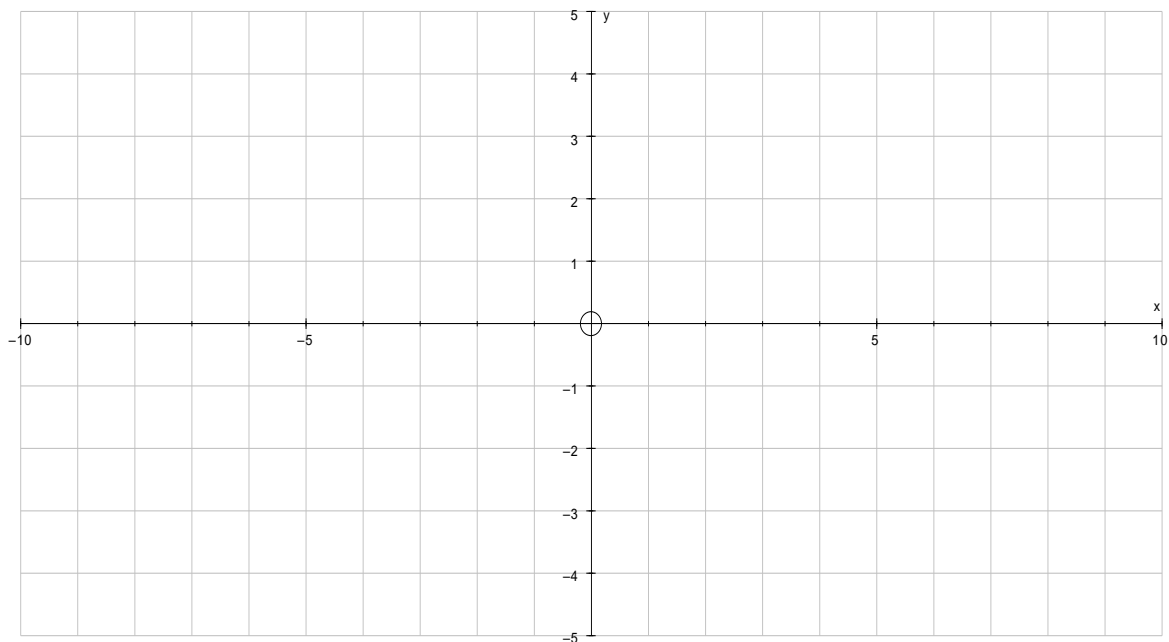
**Q 3(a)**

**[17 Marks]**

Let the following vectors  $\vec{a} = \vec{i} - 2\vec{j}$  and  $\vec{b} = -2\vec{i} - 4\vec{j}$ .

- (i) Write down  $\overrightarrow{a - b}$  in the form  $a\vec{i} + b\vec{j}$ .

- (ii) Sketch  $\vec{a}$ ,  $\vec{b}$  and  $\overrightarrow{a - b}$  as position vectors and show how the triangular law is used to calculate  $\overrightarrow{a - b}$



- (iii) Determine the angle made by the vector  $\overrightarrow{a - b}$  with the x-axis.

**Q 3(b)****[8 Marks]**

Evaluate each of the following, given the following **complex numbers**:

$$z_1 = 4 - 3i, z_2 = -15 + 8i$$

Please show all your work clearly, expressing your answers in the form  $x + yi$ :

(i)  $4z_1 - 2z_2$

(ii)  $|z_2|$  the modulus of  $z_2$

***[End of Question3]***

**QUESTION 4**

**[TOTAL MARKS: 25]**

**Q 4(a)**

**[8 Marks]**

Find all the solutions of the trigonometric equation in the interval  $0^\circ \leq \theta \leq 360^\circ$ .

$$\sin \theta = \frac{1}{\sqrt{3}}$$





**Q 4(b)**

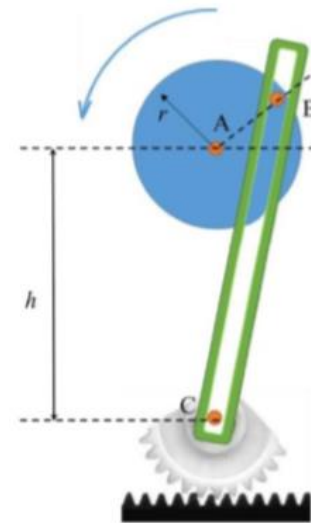
**[9 Marks]**

A mechanism converts rotational motion to linear motion through a pin (B) connected to a revolving disk in an “arm” as shown in the diagram.

While the disk rotates, the pin rotates the arm which in turn is connected to a gear. The gear is aligned with more teeth on a bar. The rotating disk and arm produces a repetitive motion.

The height ( $h$ ) from the center of the disk to the gear is 12cm and the radius ( $r$ ) of the disk is 6cm.

For the position shown in the diagram, angle  $\theta$  is  $40^\circ$ .



For the given values of  $h, r$ , and  $\theta$ ,

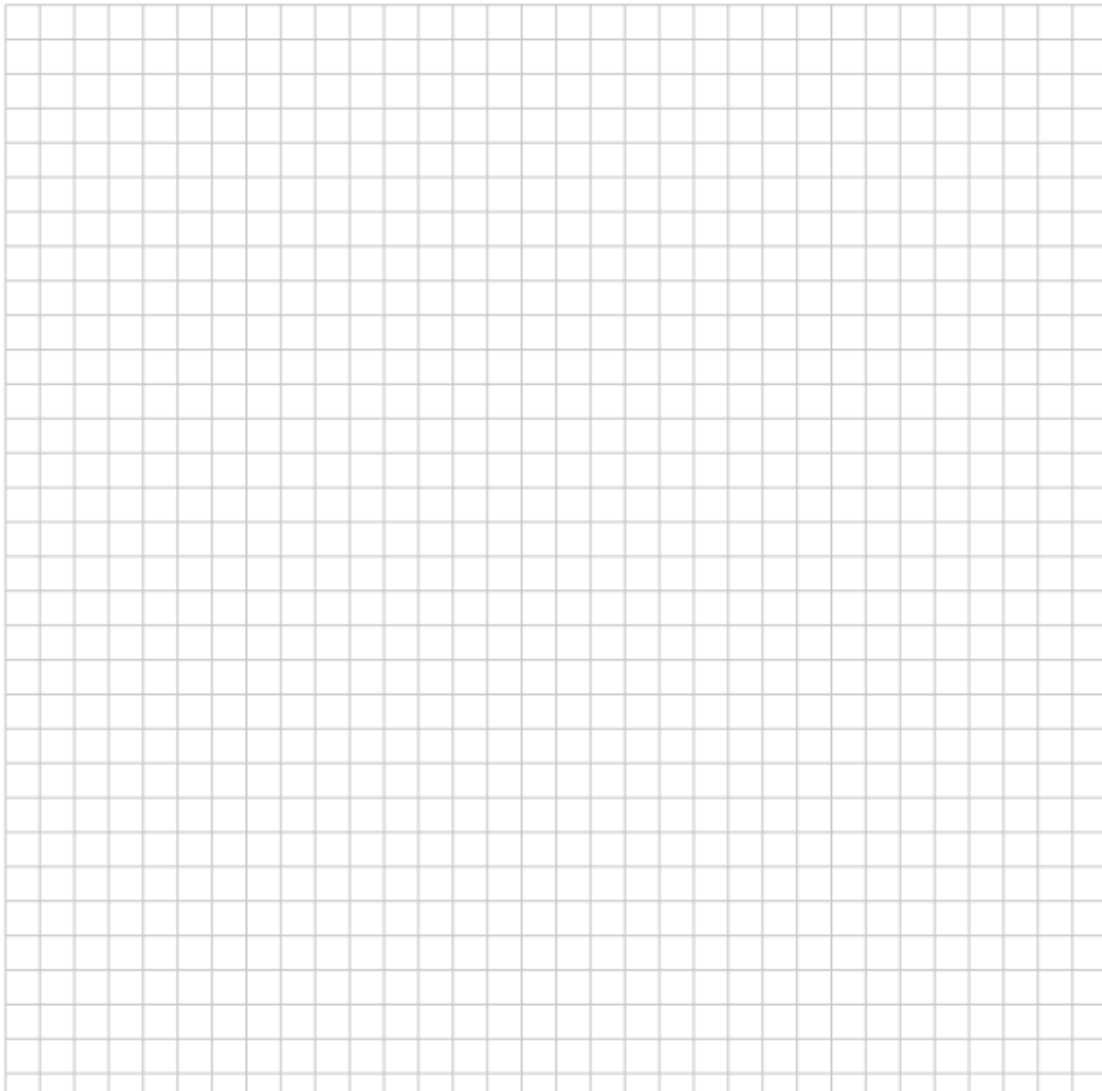
- (i) Determine the length of BC

- (ii) What is the size of the angle ABC.

**Q 4(c)**

**[8 Marks]**

State the amplitude and period of the trigonometric waveform  $y = \sin 2x$ , and draw a sketch of its graph for  $0 \leq x \leq 360^\circ$  in the graph paper below.



***[End of Question4]***

**QUESTION 5**

**[TOTAL MARKS: 25]**

**Q 5(a)**

**[18 Marks]**

- (i) Differentiate the function  $y = 8 + 2x - x^2$ ,

- (ii) Hence find the gradient of the tangent to the curve when  $x=2$ .

- (iii) Hence find the equation of the tangent to the curve when  $x=2$ .

**Q 5(b)**

**[7 Marks]**

Determine  $\int_0^1 x^3 + x - 1 dx$



***[End of Question5]***

***[END OF EXAM]***