

Autumn Examinations 2017/18

Module Title: Technological Mathematics 101

Module Code: MATH6012

School: Mechanical, Electrical and Process Engineering

Programme Title(s): Certificate Mechanical Science

Programmes Code(s): EMSCI_6_Y1

External Examiner(s): Dr. James Cruickshank

Internal Examiner(s): Ms. Sarah Murphy

Instructions: Answer Question 1 in Section A and one question from Section B

Duration: 2 hours

Sitting: Autumn 2018

Requirements for this examination: Mathematical Tables, Graph Paper

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination. If in doubt please contact an Invigilator.

SECTION A

Question 1

- a) Given the formula

$$s = ut + \frac{1}{2}at^2$$

determine the value of u , when $t = 5$, $a = 7.5$ and $s = 140.25$.

[10 marks]

- b) Simplify the following using the laws of indices giving your answer in terms of positive indices only

$$\frac{49a^{-3}b^4c^5}{7a^2b^{-2}c}$$

[10 marks]

- c) Solve for x in the following equation

$$\log(x^5) - 3\log(x) = \log(64x) - \log(4x)$$

[10 marks]

- d) Solve for x in the following quadratic equation,

$$5x^2 + 2x - 3.5 = 0$$

giving the roots correct to two decimal places.

[10 marks]

- e) The distance travelled s (metres) by an object in a time t (seconds) is described by

$$s = 18t^2 - 4t^3$$

- Find expressions for the velocity and acceleration of the object at time t .
- Find the velocity and acceleration of the object when $t = 1$ second.

[10 marks]

- f) Integrate the following

$$\int x^3 - \frac{3}{x^2} + \cos(2x) + e^x + \frac{1}{x} dx$$

[10 marks]

SECTION B

Question 1

a) Express

$$\frac{4x + 1}{(x + 1)(x - 2)}$$

as partial fractions.

[10 marks]

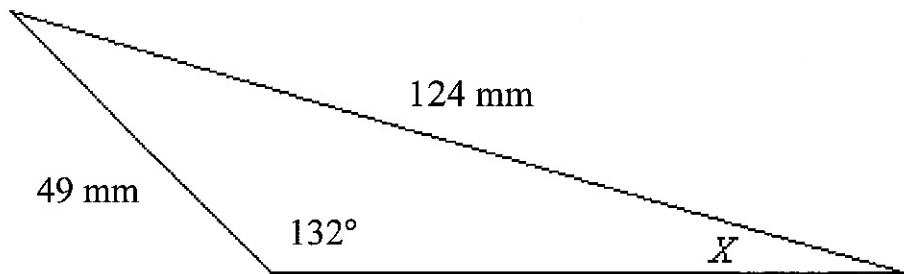
b) Express each of the following in linear form, i.e. $y = mx + c$, where m and c are constants. Indicate what you would plot along each axis and state clearly the slope and the intercept in each case.

i) $y = ax^b$, where a and b are constants.

ii) $y = a + \frac{b}{x^2}$, where a and b are constants.

[10 marks]

c) Consider the following triangle. This triangle has a side of length 49 mm, a side of length 124 mm and the angle opposite the 124 mm side is 132° .



Find

- the angle marked X correct to the nearest degree
- the area of the triangle.

[10 marks]

d) Sketch the graph of

$$\sin(x + \pi)$$

for $0 \leq x \leq 2\pi$. State the period and the amplitude.

[10 marks]

Question 2

a) Differentiate each of the following with respect to x

(i) $f(x) = \frac{9x^4}{2} - \frac{3}{x^2} + 10 - e^{-x} + \sqrt{x}$

(ii) $y = \frac{e^{3x}}{x^2}$

[10 marks]

b) Find the co-ordinates of the turning points on the curve

$$y = 2x^3 - 3x^2 - 36x + 20$$

and show by finding the second derivative, which is a maximum point and which is a minimum point.

[10 marks]

c) Determine the following integrals

i) $\int 9x^3 - \frac{4}{x^2} - \frac{2}{x} + e^{4x} dx$

ii) $\int 2xe^{x^2+4} dx$

[10 marks]

d) Find the area enclosed between the x -axis and the curve

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

between $x = 3$ and $x = 6$.

[10 marks]