

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 4

LEFEL 4

**EXAMINATION PERIOD
MAY 2021 (RESIT)**

**MODULE CODE: ACHA4000/ACMA4006
ANALYTICAL METHODS/ENGINEERING MATHEMATICS**

TIME: 1 ½ HOURS

(PLUS HALF AN HOUR TO SUBMIT SOLUTIONS – 2 HOURS IN TOTAL)

ANSWER TWO OUT OF THREE QUESTIONS

Equipment or materials required –

Calculators allowed

Formula booklet provided

SHOW ALL WORKINGS

IMPORTANT INSTRUCTIONS FOR ONLINE EXAMINATIONS:

- *You will need to submit a digital photograph or scan of each page of workings, preferably all in one Word document*
- *Please submit these to Moodle (underneath where you accessed the exam paper)*
- *Put the time, date, module code and your student number at the top of each page*
- *Number each page 'x of y'*
- *If you have any issues, email richard.sutton@uwtsd.ac.uk*

QUESTION ONE

- a) Rearrange the following formula to get x as the subject:

$$y = 2\sqrt{\frac{3}{x^3}}$$

(4 marks)

- b) Solve the following equations, using the appropriate method, for x :

(i) $\frac{2x+3}{4} = \frac{5x+1}{-3}$

(ii) $\frac{(x-1)}{2} - \frac{5x}{4} = \frac{(x+2)}{2}$

(iii) $2\log(x+3) = \log(x+5) + \log(x+7)$

(iv) $4^x \times 3^{x+5} = 2^x$

(16 marks)

- c) Factorise the following algebraic expressions **completely**:

(i) $T^2 + 11T + 30$

(ii) $4X^2 - 100Y^2$

(iii) $tr - ty + ur - uy$

(7 marks)

- d) Solve the following quadratic equations **by using the factorisation method**:

(i) $x^2 + 19x + 90 = 0$

(ii) $x^2 - 5x + 6 = 0$

(iii) $x^2 + 8x = 9$

(iv) $x^2 - 225 = 0$

(10 marks)

- e) Solve the following equation for x :

$$(x+2)^2 - x^2 - 2 = (x+5)(x+1) - x^2$$

End of question one.

(3 marks)

QUESTION TWO

a) Find the first derivative of the following functions:

(i) $y = 6x^4 - x^2 + 7x + 1$

(ii) $y = (5x - 2)(x + 5)$

(iii) $y = \frac{1}{x^5} + \ln x$

(iv) $y = \sin 3x + 2 \cos 5x - \tan 2x$

(v) $y = 5x \sin 2x$

(vi) $y = \frac{\cos 3x}{e^x}$

(vii) $y = \sqrt[5]{5x - 1}$

(21 marks)

b) Find the 4th derivative of $y = \cos 3x$

(4 marks)

c) The variable z is related to the variables x and y by the following:

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

Find the four second order partial derivatives, i.e. $\frac{\partial^2 z}{\partial x^2}, \frac{\partial^2 z}{\partial y^2}, \frac{\partial^2 z}{\partial y \partial x}, \frac{\partial^2 z}{\partial x \partial y}$.

(6 marks)

d) Given the following set of simultaneous equations, solve for x and y :

$$y = 3x^2 + 16x + 30$$

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

(6 marks)

e) If $y = 5x^2 + 4x - 1$ show that:

$$6 \left(\frac{d^2 y}{dx^2} \right) - 5 \left(\frac{dy}{dx} \right) + 7x - 1 = 39 - 43x$$

(3 marks)

End of question two.

QUESTION THREE

a)

(i) Solve the following quadratic equation by using the quadratic formula, **expressing your answers to two decimal places**:

$$15x^2 = 14x + 20$$

(7 marks)

b) Solve the following trigonometric equations for $0^\circ \leq x \leq 360^\circ$:

(i) $\cos x = 0.32$

(ii) $8 \sin x = 3$

(iii) $-10 \tan x = 3$

(iv) $-3 \cos x = -1$

(10 marks)

c) Factorise $x^2 - 7x + 10$ hence solve the following trigonometric equation for $0^\circ \leq x \leq 360^\circ$:

$$\tan^2 x - 7 \tan x + 10 = 0$$

(10 marks)

d) Transpose the following formula to get θ as the subject of the formula:

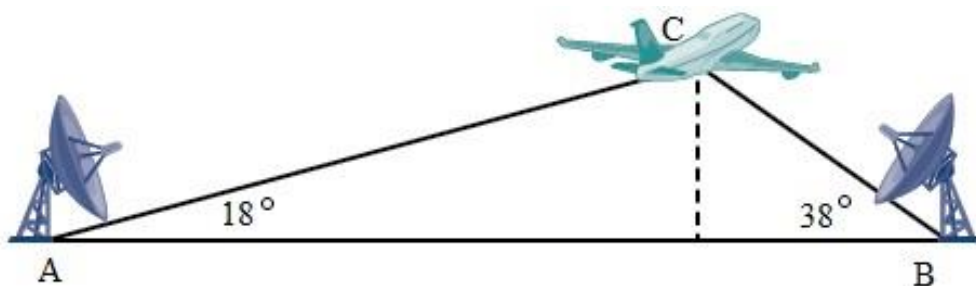
$$y = \cos^2 \left(\frac{2\theta}{5} \right)$$

(3 marks)

e) The diagram below shows two radar towers, as well as an aircraft that is airborne between them.

Radar A and radar B are 20 miles apart. The dotted line indicates the altitude of the aircraft, perpendicular to the ground.

Find the distances between each radar and the aircraft (AC and BC), as well as the altitude of the aircraft. (*Miles are the distance units throughout, triangle not drawn to scale*).



(10 marks)