ENG168

UNIVERSITY OF GREATER MANCHESTER

SCHOOL OF ENGINEERING AND BUILT ENVIRONMENT

BSc (HONS) CIVIL ENGINEERING

SEMESTER ONE EXAMINATION 2025/2026

MATHEMATICAL METHODS FOR CIVIL ENGINEERING

MODULE NO: CIE4022

Date: Monday 12th January 2026 **Time: 2pm to 4pm**

INSTRUCTIONS TO CANDIDATES:

There are 8 questions

Answer any five (5) questions.

All questions carry equal marks.

Marks for parts of questions are shown in brackets.

Electronic calculators may be used provided that data and program storage memory is cleared prior to the examination.

CANDIDATES REQUIRE:

Formula Sheet (provided).

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Question 1

(a) The angular deflection θ of a beam of electrons due to a magnetic field is given by:

$\theta = K\emptyset\left(\frac{HL}{V^{\frac{1}{2}}}\right)$. Transpose the equation for V. Then find V when H = 2, K= 3.5, L = 2.8 $\emptyset$ = 4 and $\theta = 45$ **(10 marks)**

(b) Solve the following quadratic equations by factorisation:

i. $x^2 - 2x - 15 = 0$ **(5 marks)**

ii. $x^2 + 3x - 28 = 0$ **(5 marks)**

Question 2

Solve the following systems of simultaneous linear equations:

i. $5x + 7y = 37$
$2x + 7y = 52$ **(7 marks)**

ii. $2p + 4q + r = 1$
$p - 2q - 3r = 2$
$p + q - r = -1$ **(13 marks)**

Question 3

(a) $Simplify\ the\ following$

i. $\sqrt[5]{y^2} \div \sqrt{y}$ **(5 marks)**

ii. $(2Kq^2)^5 \times 3K\sqrt{q^6}$ **(5 marks)**

(b) $Solve\ the\ following$

i. $\log_4(13x - 1) = 3$ **(5 marks)**

ii. $2\log x = 3\log 4$ **(5 marks)**

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Question 4

(a) A site foreman stacks piles of beam in a sequence where each subsequent stack contains a fixed number of piles more than the previous one. The first four stacks in the sequence contain 4, 9, 14, and 19 piles respectively.

i. Write down a formula for the nth term of this sequence to help the foreman.

ii. Find the 17th term of this sequence.

iii. Find the sum of the first thirty terms of the sequence.

(10 marks)

(b) A Geometric sequence formula is given below to model a structural component's load capacity decreases over time(years) due to fatigue.

$$X_n = \ 8\times\left(\frac{2}{3}\right)^n \text{ for n} = 0,1,2,3, \ldots\ldots$$

i. Simplify and write down the load capacity for the first four years (**0 to year 3**).

ii. Calculate the sum of load capacities for **the first 10 years**.

(10 marks)

Question 5

(a) Using Pascal's triangle, expand and simplify the following;

i. $(k+q)^4$ **(6 marks)**

ii. $(\boldsymbol{2a-3b})^{\boldsymbol{4}}$ **(10 marks)**

(b) Simplify $\left(\frac{\mathbf{1296}}{\mathbf{256}}\right)^{-\frac{3}{4}}$ **(4 marks)**

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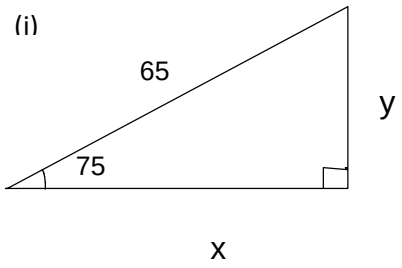
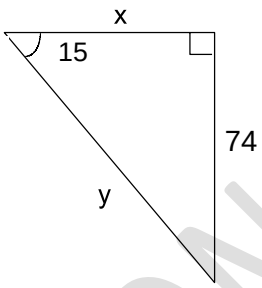
Question 6

(a) For each of the right-angled triangles below, use trigonometry to calculate the lengths *x* and *y* of the sides indicated:

(i)

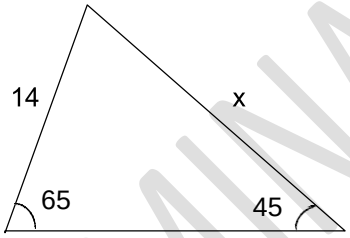


(ii)



(12 marks)

(b) Find the length *x* of the side indicated in the following triangle:



(8 marks)

Question 7

Differentiate the following functions;

i. $y = 3t^3 - 2t^2 + 5t - 3$ **(5 marks)**

ii. $y = x^5 e^{2x}$ **(7 marks)**

iii. $y = \frac{cos\, x}{x^3}$ **(8 marks)**

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Question 8

(a) Evaluate the following integral:

i. $\int_2^3 (12x^3 - 6x^2 + 8x)dx$ **(10 marks)**

(b) $Integrtae\ the\ following$

ii. $\int 2t^{-2}\, dt$ **(5 marks)**

iii. $\int (x^2 + 24x^5)\, dx$ **(5 marks)**

END OF QUESTIONS

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FORMULA SHEET

Cosine rule

$$a^2 = b^2 + c^2 - 2bc\cos(A) \quad or \quad \cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$$

$$b^2 = a^2 + c^2 - 2ac\cos(B) \quad or \quad \cos(B) = \frac{a^2 + c^2 - b^2}{2ac}$$

$$c^2 = b^2 + a^2 - 2bc\cos(C) \quad or \quad \cos(C) = \frac{a^2 + b^2 - c^2}{2ab}$$

Sine Formula

$$\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$

Sum of Arithmetic series with last term	$S_n = \frac{n}{2}(a + l)$
Arithmetic series	$a + (n-1)d$
Sum of Geometric series (infinite series)	$S_\infty = \frac{a}{(1-r)}$
Sum of Arithmetic series	$S_n = \frac{n}{2}(2a + (n-1)d)$
Geometric series	$a_n = ar^{n-1}$
Sum of Geometric series	$S_n = \frac{a(r^n - 1)}{(r-1)}$

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$$\log_a(xy) = \log_a x + \log_a y$$

$$\log_a(x) = \frac{\log_b(x)}{\log_b a} - \log_a y$$

$$\log_a a = 1$$

$$\log_a 1 = 0$$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Function	Indefinite Integral
$\int a\,dx$	$ax + C$
$\int x\,dx$	$x^2 / 2 + C$
$\int 1/x\,dx$	$\ln x + C$
$\int x^2\,dx$	$x^3 / 3 + C$
$\int \sin(x)\,dx$	$-\cos(x) + C$
$\int \cos(x)\,dx$	$\sin(x) + C$
$\int \sec^2(x)\,dx$	$\tan(x) + C$
$\int e^x\,dx$	$e^x + C$

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Derivatives or Differentiation Formulas
$\frac{d}{dx}[\sin x] = \cos x$
$\frac{d}{dx}[\cos x] = -\sin x$

Chain Rule of differentiation

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

Product Rule of differentiation

$$\frac{d(uv)}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$$

Quotient Rule of differentiation

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

END OF PAPER