

UNIVERSITY OF KENT

DIVISION OF COMPUTING, ENGINEERING
AND MATHEMATICAL SCIENCES

LEVEL 4 EXAMINATION

Foundations of Computing II

MAY/JUNE 2022

Paper Instructions
The paper contains FIVE questions. Answer FOUR questions.
Notes to Candidates
This is an open book examination to be completed and submitted within 24 hours.
This examination is designed to take two hours but you can take longer if you wish. Please ensure that you submit your answer booklet within 24 hours of the exam release time.
As you will have access to resources to complete your assessment, any content you use from external source materials should be cited. Full academic referencing is <u>not</u> required.
You are reminded of your responsibility to act with honesty, integrity and fairness in completing assessment requirements for your course, and to demonstrate good academic practice when undertaking this assessment.
This is an individual piece of work and collusion with others is strictly prohibited.
Plagiarism detection software will be in use.
Breaches of academic integrity will be considered to be academic misconduct.
Where the University believes that academic misconduct has taken place the University will investigate the case and apply academic penalties as published in Annex 10 of the Credit Framework .

1. (a) (i) Find the number of distinct words that can be made up using all the letters from the word EXAMINATION
- (ii) How many words can be made when AA must not occur?

[7 marks]

- (b) Sketch the following graphs for $-\pi < \theta < \pi$

(i) $y = 3 \cos \theta$

(ii) $y = \sin 3\theta$

[6 marks]

- (c) Solve (find all missing lengths and angles) the triangle ABC where

$AB = 5\text{cm}$, $BC = 6\text{cm}$, and angle $A = 75^\circ$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc \cos A$$

[7 marks]

2. $\underline{r}_1: A = (3,2,4) \quad \underline{m} = i + j + k$
 $\underline{r}_2: A = (2,3,1) \quad B = (4,4,1)$

(a) Create Vector and Parametric forms of the equations for lines \underline{r}_1 and \underline{r}_2

[8 marks]

(b) Find the point of intersection for the two lines

[6 marks]

(c) Find the size of the angle between the two lines

$$\underline{a} \cdot \underline{b} = |\underline{a}| \times |\underline{b}| \times \cos \theta$$

$$\underline{a} \cdot \underline{b} = (a_i \times b_i) + (a_j \times b_j) + (a_k \times b_k)$$

[6 marks]

3. (a) Differentiate:

(i) $7x^2 + 14$

(ii) $e^x(4x^2 + 3)$

[5 marks]

(b) Integrate:

(i) $\int (4x^3 - 3x^2 + 2x - 1)dx$

(ii) $\int_{z=-1}^4 \int_{y=0}^3 \int_{x=1}^2 (2xy + z)dx \, dy \, dz$

$\frac{dy}{dx} = v \frac{du}{dx} + u \frac{dv}{dx}$

[15 marks]

4. (a) Explain in words the meaning of $P(A|B)$

State the relationship between A and B when:

(i) $P(A|B) = P(A)$

(ii) $P(A|B) = 0$

[4 marks]

- (b) The events A and B are such that $P(A) = \frac{4}{9}$ $P(A|B) = \frac{1}{2}$ $P(A \cup B) = \frac{2}{3}$

- (i) Draw a Venn diagram to represent the information

[4 marks]

Calculate:

(ii) $P(B)$

(iii) $P(B|A)$

(iii) $P(A \cap B)$

(iv) $P(A \cup \overline{B})$

(v) $P(\overline{A} | \overline{B})$

- (vi) Represent the information as a tree diagram with B preceding A

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

[12 marks]

5. (a) Solve the simultaneous equations:

$$\begin{cases} 4x + 2y = 20 \\ 5x - 2y = 7 \end{cases}$$

[3 marks]

(b) $M = \begin{pmatrix} 4 & 2 \\ 5 & -2 \end{pmatrix}$ $N = \begin{pmatrix} 20 \\ 7 \end{pmatrix}$

Find:

(i) M^{-1}

[6 marks]

(ii) $M^{-1}N$

[3 marks]

(c) $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}$ $B = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$

Find AB and explain why BA cannot be found.

[8 marks]