

ENGR121 Test One

During lecture, 13 April 2018

Surname:
First Name:
Student Number:

Please use the spaces provided in this test booklet next to the questions, to give your answers. Please show all working. You may use page five for rough working if you need more space, plus the reverse sides of all pages.

Attempt all SEVEN questions. The first six questions are of equal value, seven marks each. The seventh question is worth eight marks. The marks for parts of questions are given in square brackets, e.g. [1].

Silent calculators may be used. A table of formulae is provided.

Page totals, for marking use only

Page	Mark	max
p.2		21
p.3		14
p.4		15
Total		50

1. State whether each of the following is true or false [1 mark each]:

(a) $-7 \in \mathbb{Z}$

(b) $\pi \in \mathbb{R}$

(c) $-7.7 \in \mathbb{N}$

(d) $-7.777 \in \mathbb{Q}$

(e) $\sqrt{4} \in \mathbb{Z}$

(f) $\mathbb{Z} \subset \mathbb{Q}$

(g) $\mathbb{N} \cap \mathbb{R} = \mathbb{Q}$

2. Simplify where possible the following operations on sets:

(a) $A \cap \mathbb{E}$ [1]

(b) $B \cup \overline{B}$ [1]

(c) $A \cup \phi$ [1]

(d) $\overline{\phi}$ [2]

(e) $A \cup (A \cap \overline{B})$ [2]

3. (a) Sketch a graph of the function $f(x) = x^2 - 2$. [2]

(b) Is the function $f(x) = 3x + 1$ one-to-one? [1]

(c) Is the function $f(x) = x^2 - \pi$ one-to-one? [1]

(d) Can a function be many-to-one? [1]

(e) If $f(x) = 3 - 1/x$, find the inverse function $f^{-1}(x)$. [1]

(f) Write down the composition $f(g(x))$ if $f(x) = 3x^2$ and $g(x) = \sin(x - 1)$. [1]

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4. (a) Write down the graphical symbol for an AND gate. [1]

(b) Write down the truth table for an AND gate with inputs A and B. [1]

(c) Construct the truth table for $\overline{A} \cdot B + A$. [2]

(d) Draw a circuit diagram for $A \cdot (\overline{B} + C)$ using NOT, AND and OR gates. [2]

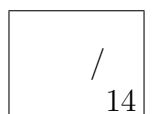
(e) Simplify the logical expression $A \cdot \overline{A}$ [1]

5. (a) Write the disjunctive normal form for a boolean expression that has the truth table [3]

A	B	C	X
1	1	1	1
1	1	0	0
1	0	1	0
1	0	0	0
0	1	1	1
0	1	0	0
0	0	1	1
0	0	0	0

(b) Simplify the d.n.f obtained in part (a), if possible. Show all working. [3]

(c) Draw a circuit diagram for the boolean expression you obtained in part (b) [1]



6. (a) Simplify $w^3(w^{-2})^2$. [1]

7. (a) Use the Fundamental Laws of Set Algebra (see Formula Sheet) to prove that, for any sets A and B , [5]

$$A \cap (A \cup B) = A$$

(b) Find the roots of $2x - 1 = 3x - 3$, showing your working, without using a calculator. [2]

(b) Describe the vertical asymptotes of the rational function [2]

$$\frac{x + 1}{x^2 + 2x}$$

(c) Solve the quadratic equation $x^2 + 2x - 1 = 0$ using any method except a calculator. Show your working. [2]

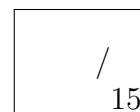
(c) Find a formula for the oblique asymptote of the rational function [1]

$$\frac{2x^2 + x + 1}{x + 2}$$

(d) Solve the polynomial equation $x^3 = x^2$. [1]

(e) Solve the inequality $x^2 < 9$ [1]

***** END OF TEST *****



Use this page and the other side for rough working if needed.