Test #1

Some items of this test are multiple choice questions. A good answer earns 2 points and any wrong answer costs 1 point, a missing answer earns or costs nothing. Other items are free response questions, all of them worth 4 points, where any incomplete or imperfect answer will be rewarded.

Section 1 – Syllogisms

QUESTIONS	ANSWERS
1. Is the following syllogism valid, true, neither of both? No horses are blue. Some birds are blue. No birds are horses.	❒ True ❒ Valid ❒ Neither ❒ Both
2. Is the following syllogism valid, true, neither of both? Driving a big car uses a lot of gas. Using a lot of gas is expensive. Driving a big car is expensive.	❒ True ❒ Valid ❒ Neither ❒ Both
3. What is the middle term in the following syllogism? All sunny days are great. Some mondays are sunny days. Some Mondays are great.	❒ Sunny days ❒ Great ❒ Mondays ❒ Are
4. What is the total number of valid types of syllogisms.	❒ 256 ❒ 19 ❒ 4 ❒ 42
5. The letter A stands for	❒ Universal affirmative. ❒ Universal negative. ❒ Particular affirmative. ❒ Particular negative.

6. Write a "Barbara" syllogism of your own invention.

Section 2 – Formal logic and equivalences

1. Match each logical operator to the right truth table.

$p \wedge q$ ❒ $p \vee q$ ❒ $p \to q$ ❒ $p \leftrightarrow q$ ❒

❒

p	q	
0	0	1
0	1	0
1	0	0
1	1	1

❒

p	q	
0	0	1
0	1	0
1	0	1
1	1	1

❒

p	q	
0	0	0
0	1	1
1	0	1
1	1	1

❒

p	q	
0	0	0
0	1	0
1	0	0
1	1	1

❒

p	q	
0	0	1
0	1	1
1	0	0
1	1	1

❒

p	q	
0	0	0
0	1	0
1	0	1
1	1	1

QUESTIONS	ANSWERS
2. The proposition $p \to q$ is formally equivalent to	❒ $q \to p$ ❒ $\neg q \to \neg p$ ❒ $\neg p \to \neg q$ ❒ $p \leftrightarrow q$
3. The proposition $\neg(p \vee q)$ is formally equivalent to	❒ $p \wedge q$ ❒ $\neg p \wedge \neg q$ ❒ $\neg p \vee \neg q$ ❒ $p \vee q$
4. The proposition $\neg(p \wedge q)$ is formally equivalent to	❒ $p \wedge q$ ❒ $\neg p \wedge \neg q$ ❒ $\neg p \vee \neg q$ ❒ $p \vee q$
5. The proposition $p \leftrightarrow q$ is formally equivalent to	❒ $(p \to q) \wedge (q \to p)$ ❒ $(p \to q) \vee (q \to p)$ ❒ $(p \to q) \wedge (p \to \neg q)$ ❒ $(p \to q) \vee (p \to \neg q)$

6. Prove, by building their truth tables, that the following propositions are formally equivalent.

$$\neg(r \to p \vee q) \text{ and } \neg p \wedge \neg q \wedge r.$$

Section 3 – Venn diagrams

1. Draw a Venn diagram with two sets A and B such that $x \in A \to x \in B$.

2. Draw a Venn diagram with three sets A, B and C such that $A \subset B$ and $C \subset \overline{B}$.

The following multiple choice questions are all about the configuration you represented in the question 2.

QUESTIONS	ANSWERS
3. The intersection $A \cap B$ is equal to	❒ $\varnothing$ ❒ A ❒ B ❒ Neither of these sets.
4. The intersection $A \cap C$ is equal to	❒ $\varnothing$ ❒ A ❒ B ❒ Neither of these sets.
5. The intersection $B \cap C$ is equal to	❒ $\varnothing$ ❒ A ❒ B ❒ Neither of these sets.
6. Is the equality $A \cup B = A$ true of false in this situation ?	❒ True ❒ False ❒ It's impossible to say
7. Is the equality $A \cup B = B$ true of false in this situation ?	❒ True ❒ False ❒ It's impossible to say
8. Is the inclusion $A \cup C \subset B$ true of false in this situation ?	❒ True ❒ False ❒ It's impossible to say
9. Is the equality $B \cup C = \Omega$ true of false in this situation ?	❒ True ❒ False ❒ It's impossible to say
10. Is the equality $B \cup \overline{A} = \Omega$ true of false in this situation ?	❒ True ❒ False ❒ It's impossible to say

Section 4 – Set-builder notation

1. Match each set definition with the right partial list of elements.

$\{n^2 : n \in \mathbf{N} \cap [2,7]\}$	$\{x \in \mathbf{R} : x^2 = 2x\}$	$\{3k+1 : k \in \mathbf{Z}\}$	$\{n : n \in \mathbf{Z} \wedge \frac{15}{n} \in \mathbf{Z}\}$
❒	❒	❒	❒
❒ 2, 0	❒ 16, 37, 10	❒ 16, 36, 9	❒ 1, 3, 15

QUESTIONS	ANSWERS
2. Which one of the following sets is empty ?	❒ $\{n \in \mathbf{N} : n^2 = 4\}$ ❒ $\{n \in \mathbf{N} : n^2 = 5\}$ ❒ $\{n \in \mathbf{R} : n^2 = 4\}$ ❒ $\{n \in \mathbf{R} : n^2 = 5\}$
3. The notation $\mathbf{R}^+$ denotes what set ?	❒ $\mathbf{N}$ ❒ $]0;+\infty[$ ❒ $[0;+\infty[$ ❒ $\mathbf{Q}^+$
4. The natural numbers are the elements of what set ?	❒ $\mathbf{N}$ ❒ $\mathbf{N}^\star$ ❒ $\mathbf{Z}$ ❒ $\mathbf{Z}^\star$
5. Only one of the following statements is true. Which one ?	❒ $\forall x \in \mathbf{R},\ x^2 = 5$ ❒ $\forall x \in \mathbf{Z},\ x^2 = 5$ ❒ $\exists x \in \mathbf{R},\ x^2 = 5$ ❒ $\exists x \in \mathbf{Z},\ x^2 = 5$

6. Explain in a few words Russell's paradox.