Question 1. [6 MARKS]

Part (a) [1 MARK]

Nothing

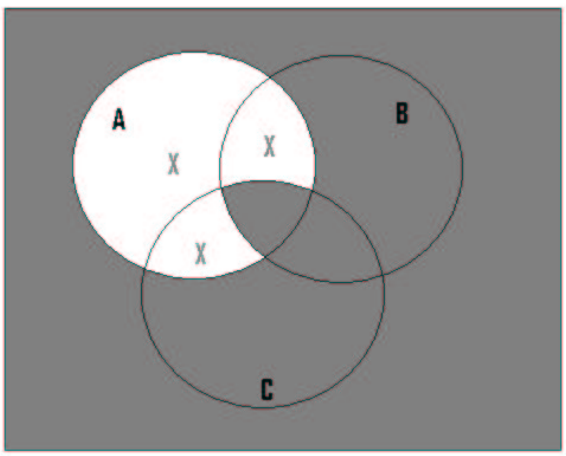
Part (b) [1 MARK]

B and C are true

Part (c) [2 MARKS]

If A, then not, not B or not C.
or
If not B or not C, then not A.

Part (d) [2 MARKS]



Question 2. [8 MARKS]

Part (a) [2 MARKS]

$\neg\exists x \in M, S(x,x)$
or
$\forall x \in M, \neg S(x,x)$

Part (b) [2 MARKS]

$\forall y \in M, \exists x \in M, S(x,y)$

Part (c) [2 MARKS]

$\exists x \in M, \forall y \in M, S(x,y)$
One could argue for it being like part (b).

Part (d) [2 MARKS]

$\forall y \in M, \neg S(Pi,y)$
or
$\neg\exists y \in M, S(Pi,y)$

Question 3. [3 MARKS]

Note: we added `else return true;` to this.

```
return (A && (B || (!B && C && (C && D)))) || !A;
```

or

```
return B || (C && D) || !A;
```

Question 4. [8 MARKS]

Part (a) [2 MARKS]

$\forall i \in \mathbb{N}, \exists j \in \mathbb{N}, a_j > i \wedge j \leq i$

Part (b) [4 MARKS]

True. For example, $i = 8$.

False.

Part (c) [2 MARKS]

Let $i =$ ___.
  ___, so $i \in \mathbb{N}$.
  Let $j \in \mathbb{N}$.
  Suppose $a_j > i$.
    ___
    Then $j > i$.
  So $a_j > i \rightarrow j > i$.
  Since j is an arbitrary element of $\mathbb{N}$:
    $\forall j \in \mathbb{N}, a_j > i \rightarrow j > i$.
Since $i \in \mathbb{N}$, and $\forall j \in \mathbb{N}, a_j > i \rightarrow j > i$:
  $\exists i \in N, \forall j \in \mathbb{N}, a_j > i \rightarrow j > i$.

Total Marks = 25