Q1

Original Method		With Embedded Mutants
int Min (int A, int B)		int Min (int A, int B)
{		{
int minVal;		int minVal;
minVal = A;		minVal = A;
if (B < A)	Δ1	minVal = **B**;
{		if (B < A)
minVal = B;	Δ2	if (B **>** A)
}	Δ3	if (B < **minVal**)
return (minVal);		{
} // end Min		minVal = B;
	Δ4	**Bomb()**;
	Δ5	minVal = **A**;
	Δ6	minVal = **failOnZero (B)**;
		}
		return (minVal);
		} // end Min

Figure 5.1. Method Min and six mutants.

Mutant 2:
Reachability: Will always be reached; true
Infection: (B < A) ≠ (B > A) , or A ≠ B
Propagation: Will always propagate. ; true

Full test specification: true ∧ (A ≠ B) ∧ true = (A ≠ B).

Test case : A=5, B = 7

Mutant 4:
Reachability: if (B<A) true , mutant 4 will be reached; (B < A) = true
Bomb() signals a failure as soon as it is executed, so the infection and propagation will be true.
Infection: true
Propagation: true
Full test specification: (B < A) ∧ true ∧ true = (B < A)
Test case : A=7, B = 5

Mutant 5:
Reachability: if (B<A) true , mutant 5 will be reached; (B < A) = true
Infection will occur if value of A and B are different.
Infection: A ≠ B
Propagation: true

Full test specification: (B < A) ∧ (A ≠ B) ∧ true = (B < A)
Test case : A=7, B = 5

Mutant 6:
Reachability: if (B<A) true , mutant 6 will be reached; (B < A) = true
failOnZero() will signal a failure as soon as B is zero. And if B is zero, the mutant will be killed.
So,
Infection : B = 0
Propagation: true
Full Test specification : (B < A) ∧ (B = 0) ∧ true = (B < A) ∧ (B = 0)
Test case ; A = 2, B = 0.

Q2.

When the mujava tool was used to mutate the implementation of the roman program, total 480 mutants were generated. All of the generated mutants were traditional mutants, and none of the generated mutants were class mutants.
The number of different types of traditional mutants that were generated were the following:

AORB	52
AORS	0
AOIU	2
AOIS	68
AODU	0
AODS	0
ROR	112
COR	2
COD	0
COI	19
SOR	0
LOR	0
LOI	18
LOD	0
ASRS	52
SDL	101
VDL	0

CDL	13
ODL	41

The results were the following for traditional mutants:

Live Mutants #	57
Killed Mutants #	423
Total Mutants #	480
Mutant Score	88.0%